

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

POSITEC USA INC., a North Carolina Corporation
and POSITEC USA INC., a South Carolina
Corporation,

Plaintiffs,

v.

MILWAUKEE ELECTRIC TOOL
CORPORATION,

Defendant.

Case No. 05-CV-

COMPLAINT FOR DECLARATORY JUDGMENT

Plaintiffs Positec USA Inc. (a North Carolina Corporation) and Positec USA Inc. (a South Carolina Corporation) (collectively, “Positec USA”) bring this action to obtain a declaratory judgment that Positec USA’s manufacture, use, sale, offer for sale and importation of its WORX Circular Saw do not infringe any valid claim of United States Patent Nos. 6,108,916, 6,301,790, and 6,588,112 (the “Patents-in-Suit”). This action is filed pursuant to 28 U.S.C. §§ 2201 and 2202 for the purpose of resolving an actual and justiciable controversy between Positec USA and Defendant Milwaukee Electric Tool Corporation.

Parties

1. Plaintiff Positec USA Inc. (North Carolina) is a corporation organized under the laws of the state of North Carolina with its principal place of business at 9009 Perimeter Woods Drive, Suite 1, Charlotte, North Carolina 28216 29615.

2. Plaintiff Positec USA Inc. (South Carolina) is a corporation organized under the laws of the state of South Carolina with its principal place of business at 3519 Pelham Road, Greenville, South Carolina 29615.

3. Plaintiffs Positec USA Inc. (North Carolina) and Positec USA Inc. (South Carolina) are in the process of merging into a single North Carolina corporation. Plaintiffs Positec USA Inc. (North Carolina) and Positec USA Inc. (South Carolina) (collectively, “Positec USA”) sell, offer to sell and import the WORX Circular Saw in the United States.

4. On information and belief, Defendant Milwaukee Electric Tool Corporation (“Defendant”) is a corporation organized under the laws of the state of Delaware with its principal place of business at 13135 West Lisbon Road, Brookfield, WI 53005.

Jurisdiction and Venue

5. Positec USA brings this action under the Declaratory Judgment Act, 28 U.S.C. §§ 2201 and 2202, to obtain a judicial declaration that the Patents-in-Suit, purportedly owned by Defendant, have not been infringed by Positec USA or its customers, and are invalid. This action arises under the patent laws of the United States, 35 U.S.C. §§ 1 et seq., and is based upon an actual and justiciable controversy between the parties with respect to the infringement and validity of the Patents-in-Suit.

6. This Court has jurisdiction under 28 U.S.C. §§ 1331, 1338(a), 2201 and 2202.

7. Venue is proper before this court pursuant to 28 U.S.C. §§ 1391(b), (c), and 1400(b) because the claims involve federal questions of patent law and Defendant, a Delaware corporation, is subject to personal jurisdiction in this district.

8. Defendant is subject to general and specific jurisdiction in this Court.

Defendant’s Allegations of Patent Infringement Against Positec USA

9. Positec USA sells the WORX Circular Saw in the United States. The WORX Circular Saw is manufactured in China by Positec Machinery Co. Ltd.

10. Defendant has contended that sales of the WORX Circular Saw in the United States infringes its proprietary rights existing under the Patents-in-Suit. The Patents-in-Suit are:

- a. United States Patent No. 6,108,916 (“the ‘916 Patent”), which issued on August 29, 2000, and is entitled “Movable Handle for a Power Tool.” A copy of the ‘916 Patent is attached as Exhibit A.
- b. United States Patent No. 6,301,790 (“the ‘790 Patent”), which issued on October 16, 2001, and is entitled “Movable Handle for a Power Tool.” A copy of the ‘790 Patent is attached as Exhibit B.
- c. United States Patent No. 6,588,112 (“the ‘112 Patent”), which issued on July 8, 2003, and is entitled “Movable Handle for a Power Tool.” A copy of the ‘112 Patent is attached as Exhibit C.

11. On information and belief, Defendant owns the Patents-in-Suit.

12. Between September 2005 and December 2005, Defendant has repeatedly asserted that the WORX Circular Saw infringes one or more of the Patents-in-Suit. For example, on September 9, 2005, Defendant sent a letter to Positec Germany GmbH which alleged that Defendant was the owner of the Patents-in-Suit and that the WORX Circular Saw includes a feature that “is proprietary and a valuable property right of” Defendant.

13. On October 10, 2005, Defendant sent a letter to Positec Machinery Co. Ltd. of China. This letter, like the September 9, 2005 letter, alleged that Defendant was the owner of the Patents-in-Suit and that the WORX Circular Saw includes a feature that “is proprietary and a valuable property right of” Defendant.

14. On October 23, 2005, Ms. Wu of Positec Machinery Co. Ltd. of China responded to Defendant's letters by denying the allegation of patent infringement. "We have read both of your letters carefully and we feel Positec does not make use of any valid claim of [Defendant]."

15. Despite Positec's denial of infringement, Defendant continued to charge patent infringement. In fact, in a December 15, 2005 letter, Defendant increased its threats and now demanded that Positec "immediately cease" all sales of the WORX Circular Saw or Defendant "will be forced to commence an infringement action."

16. Defendant's December 15, 2005 letter to Positec Machinery Co. Ltd. of China specifically threatened to bring an infringement lawsuit unless the advertising, offering for sale, sale, use, and manufacture of the WORX Circular Saws ceases by December 29, 2005. In this same letter, Defendant alleged that the WORX Circular Saw infringes "at least Claims 1-2, 4, 6, 32-35, 37, and 39-40 of [Defendant's] '112 Patent." Defendant demanded that the advertising, offering for sale, sale, use, and manufacturing of the WORX Circular Saws "immediately cease": "Your company must **immediately** cease the advertisement, offering for sale, sale, use and manufacture of these infringing WORX Circular Saws and other substantially similar infringing circular saws or power tools."

17. Defendant further threatened in the December 15, 2005 letter that if sales of the WORX Circular Saw did not cease, then a patent infringement action would be commenced: "We expect confirmation that your company has indeed ceased infringement of [Defendant's] intellectual property rights no later than December 29, 2005. If your company fails to cease its infringing activities, [Defendant] will be forced to commence an infringement action to enforce its intellectual property rights and to stop your company's infringement."

18. The letter concludes by repeating the demand to “immediately cease” sale of the WORX Circular Saw and threatening litigation: “Again, we expect your company to **immediately** cease the advertisement, offering for sale, sale, use and manufacture of the infringing WORX Circular Saw and other substantially similar circular saws or power tools. Also, no later than **December 29, 2005**, we expect confirmation that your company has indeed ceased infringement of [Defendant’s] intellectual property rights. Absent a confirmation from you by that deadline, we will be forced to take alternative action.”

19. In addition to alleging infringement of the ‘112 Patent, Defendant’s December 15, 2005 letter also alleged that the WORX Circular Saw also falls within the scope of Defendant’s U.S. Patent Application Publication No. 2004/0003698 A1.

20. Positec USA denies that its advertising, offering for sale, sale, use and manufacture of the WORX Circular Saw infringes or is infringing the Patents-in-Suit. Positec USA will not cease sales and importation of the WORX Circular Saw, despite Defendant’s demands and threats. Accordingly, there exists an actual and justiciable controversy between Positec USA and Defendant concerning infringement and validity of the Patents-in-Suit.

21. In sum, Defendant’s conduct has caused Positec USA to reasonably and legitimately apprehend that Defendant will sue Positec USA for infringement of the Patents-in-Suit on account of its ongoing sales of the WORX Circular Saw.

Count I

(Declaratory Judgment Regarding the ‘916 Patent)

22. Positec USA incorporates by reference and realleges Paragraphs 1 through 21 of this Complaint.

23. The manufacture, use, sale, offer to sell, and/or importation of Positec USA's WORX Circular Saw does not infringe and has not infringed any valid claim of the '916 Patent. In addition, the manufacture, use, sale, offer to sell, and/or importation of Positec USA's WORX Circular Saw does not contribute to or induce the infringement of any valid claim of the '916 Patent; nor has Positec USA ever contributed to or induced the infringement of any such valid claim. Positec USA, its customers, and all others have the right to manufacture, have made, use, sell, offer to sell, and import Positec USA's WORX Circular Saw unhampered and unrestricted by Defendant.

24. The claims of the '916 Patent are invalid for failure to comply with one or more provisions of the Patent Laws of the United States of America, Title 35, United States Code, Sections 101 et seq., including without limitation Sections 102, 103 and/or 112.

25. There is an actual and justiciable controversy between Positec USA and Defendant over the validity and infringement of the '916 Patent.

Count II

(Declaratory Judgment Regarding the '790 Patent)

26. Positec USA incorporates by reference and realleges Paragraphs 1 through 25 of this Complaint.

27. The manufacture, use, sale, offer to sell, and/or importation of Positec USA's WORX Circular Saw does not infringe and has not infringed any valid claim of the '790 Patent. In addition, the manufacture, use, sale, offer to sell, and/or importation of Positec USA's WORX Circular Saw does not contribute to or induce the infringement of any valid claim of the '790 Patent; nor has Positec USA ever contributed to or induced the infringement of any such valid claim. Positec USA, its customers, and all others have the right to manufacture, have made, use,

sell, offer to sell, and import Positec USA's WORX Circular Saw unhampered and unrestricted by Defendant.

28. The claims of the '790 Patent are invalid for failure to comply with one or more provisions of the Patent Laws of the United States of America, Title 35, United States Code, Sections 101 et seq., including without limitation Sections 102, 103 and/or 112.

29. There is an actual and justiciable controversy between Positec USA and Defendant over the validity and infringement of the '790 Patent.

Count III

(Declaratory Judgment Regarding the '112 Patent)

30. Positec USA incorporates by reference and realleges Paragraphs 1 through 29 of this Complaint.

31. The manufacture, use, sale, offer to sell, and/or importation of Positec USA's WORX Circular Saw does not infringe and has not infringed any valid claim of the '112 Patent. In addition, the manufacture, use, sale, offer to sell, and/or importation of Positec USA's WORX Circular Saw does not contribute to or induce the infringement of any valid claim of the '112 Patent; nor has Positec USA Inc. ever contributed to or induced the infringement of any such valid claim. Positec USA, its customers, and all others have the right to manufacture, have made, use, sell, offer to sell, and import Positec USA's WORX Circular Saw unhampered and unrestricted by Defendant.

32. The claims of the '112 Patent are invalid for failure to comply with one or more provisions of the Patent Laws of the United States of America, Title 35, United States Code, Sections 101 et seq., including without limitation Sections 102, 103 and/or 112.

33. There is an actual and justiciable controversy between Positec USA and Defendant over the validity and infringement of the '112 Patent.

PRAYER FOR RELIEF

WHEREFORE, Positec USA asks this Court to enter judgment in Positec USA's favor against Defendant granting the following relief:

A. A declaration that the WORX Circular Saw does not infringe and has infringed any of the claims of the Patents-in-Suit under any subsection of 35 U.S.C. § 271;

B. A declaration that the claims of the Patents-in-Suit are invalid under 35 U.S.C. §§ 102, 103, and/or 112;

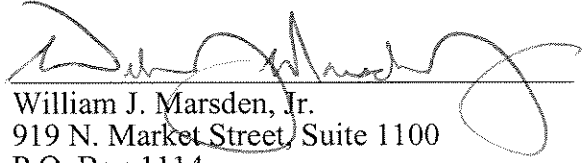
C. An order enjoining Defendant and its respective officers, partners, employees, agents, parents, subsidiaries, and affiliates from suing or threatening to sue for infringement of any of the Patents-in-Suit on the basis of the making, using, selling, offering for sale or importing of any WORX Circular Saw products; and

E. Any such other and further relief, including an award of Positec USA's costs of suit and attorneys' fees to the extent permitted by law, that this Court deems just and proper.

Dated: December 27, 2005

FISH & RICHARDSON P.C.

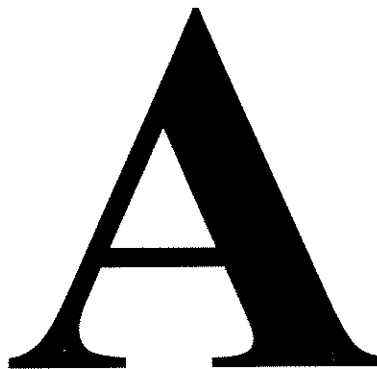
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US006108916A

United States Patent [19][11] **Patent Number:** **6,108,916****Zeiler et al.**[45] **Date of Patent:** **Aug. 29, 2000**[54] **MOVABLE HANDLE FOR A POWER TOOL**5,347,902 9/1994 Brickner et al. 83/468.3
5,687,483 11/1997 Neubert et al. 30/312[75] **Inventors:** Jeffrey Michael Zeiler, Pewaukee;
Scott George Ahlswede, Plymouth;
Richard Paul Brault, Cedarburg;
Jeffrey Scott Holly, Menomonee Falls;
Jeffrey Charles Hessenberger, Neosho;
Thomas Paul James, Oconomowoc, all
of Wis.**FOREIGN PATENT DOCUMENTS**

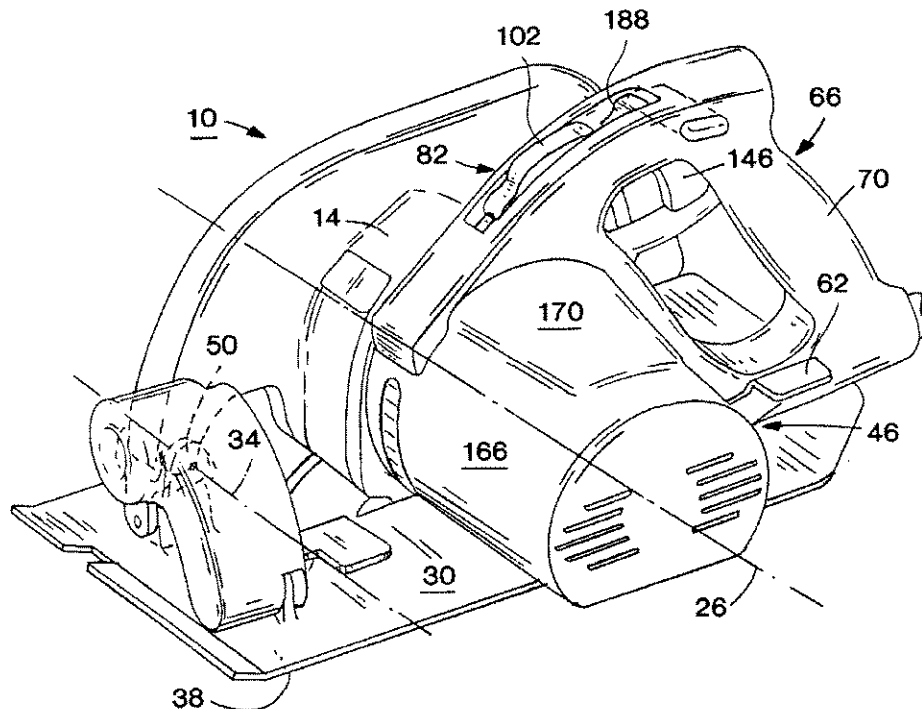
0493033 A1 7/1992 European Pat. Off. .

Primary Examiner—Douglas D. Watts*Attorney, Agent, or Firm*—Michael Best & Friedrich LLP[57] **ABSTRACT**

A movable handle for a power tool. The power tool comprises a housing, a motor supported by the housing and operable to drive a tool element about an axis, and a handle supported by the housing for rotation relative to the housing about the axis. Preferably, the power tool is a circular saw. The circular saw further comprises a switch assembly supported on the handle for movement with the handle and means for connecting the switch to the motor to accommodate movement of the switch relative to the motor. The switch assembly is electrically connectable to the motor and selectively connects the motor to a power source, and the connecting means includes a wiring arrangement. The circular saw further comprises a locking assembly for locking the handle in a position relative to the housing. Also, the circular saw preferably comprises means for preventing the switch assembly from connecting the motor to the power source when the locking assembly is in the unlocked condition and means for preventing the locking assembly from being operated from the locked condition to the unlocked condition when the switch assembly is in the operated condition.

[73] **Assignee:** Milwaukee Electric Tool Corporation,
Brookfield, Wis.[21] **Appl. No.:** 09/134,626[22] **Filed:** Aug. 14, 1998[51] **Int. Cl.⁷** B23D 45/16; B27B 9/00[52] **U.S. Cl.** 30/391; 30/375; 30/388[58] **Field of Search** 30/388-391, 382,
30/519, 375; 188/77 W[56] **References Cited****U.S. PATENT DOCUMENTS**

4,276,675 7/1981 Pioch .
4,516,324 5/1985 Heining, Jr. et al. 30/377
4,693,008 9/1987 Velie 30/390
4,856,394 8/1989 Clowers 83/56
4,870,758 10/1989 Fushiya 30/388
4,991,298 2/1991 Matre 30/392
5,005,295 4/1991 Fushiya 30/391 X
5,075,976 12/1991 Young 30/391
5,129,300 7/1992 Kawakami 83/471.2
5,239,756 8/1993 Matzo et al. 30/371

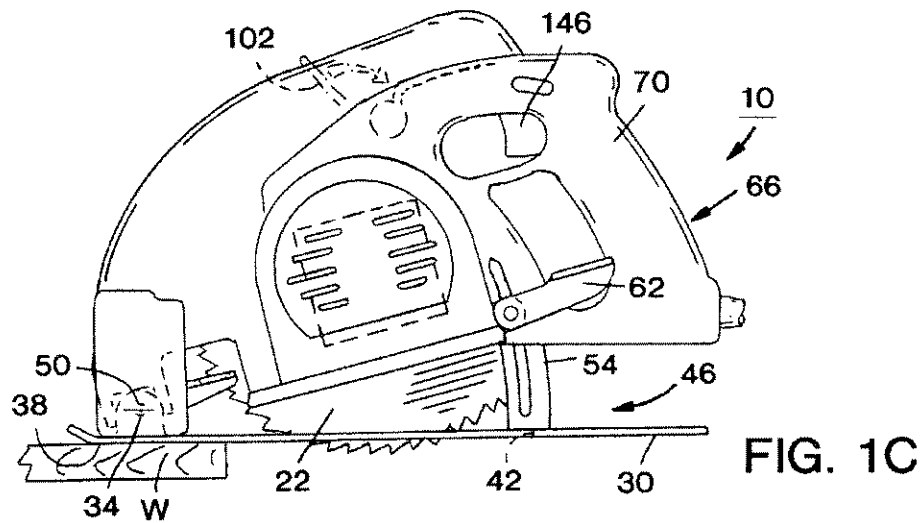
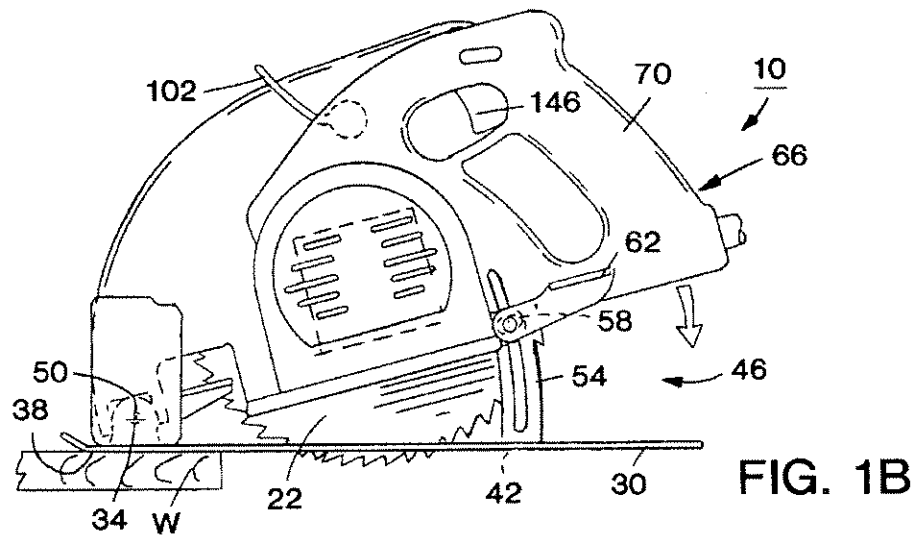
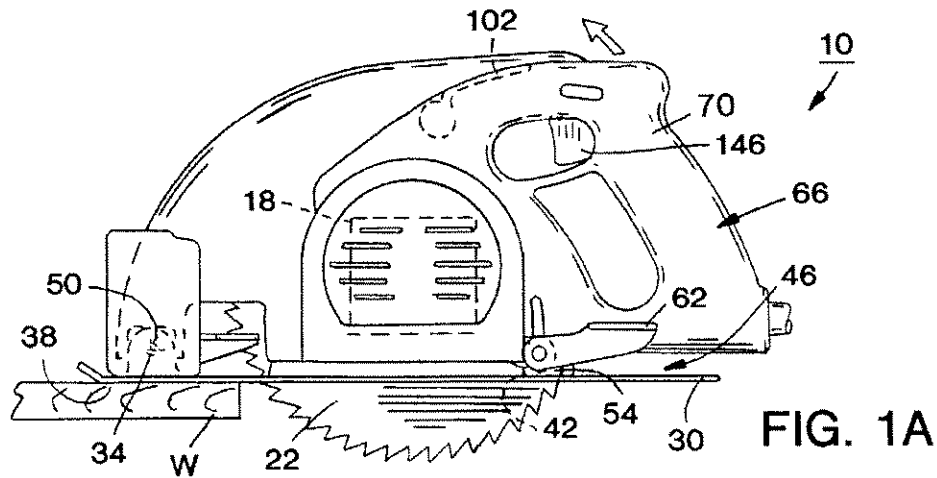
26 Claims, 7 Drawing Sheets

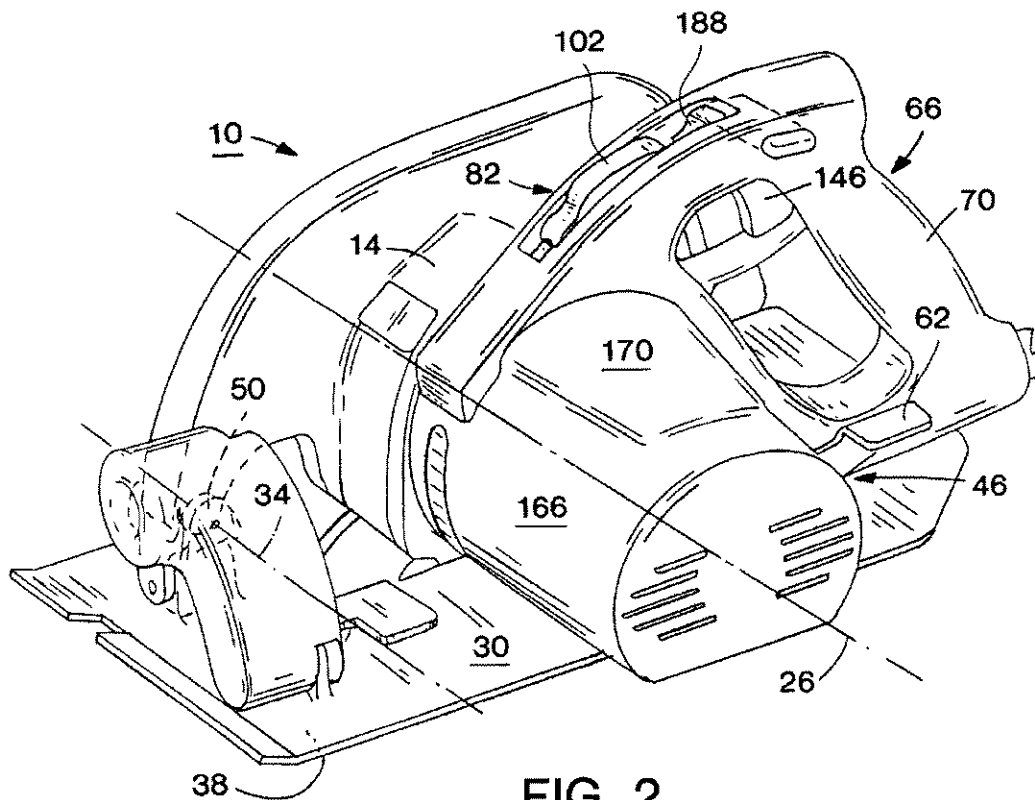
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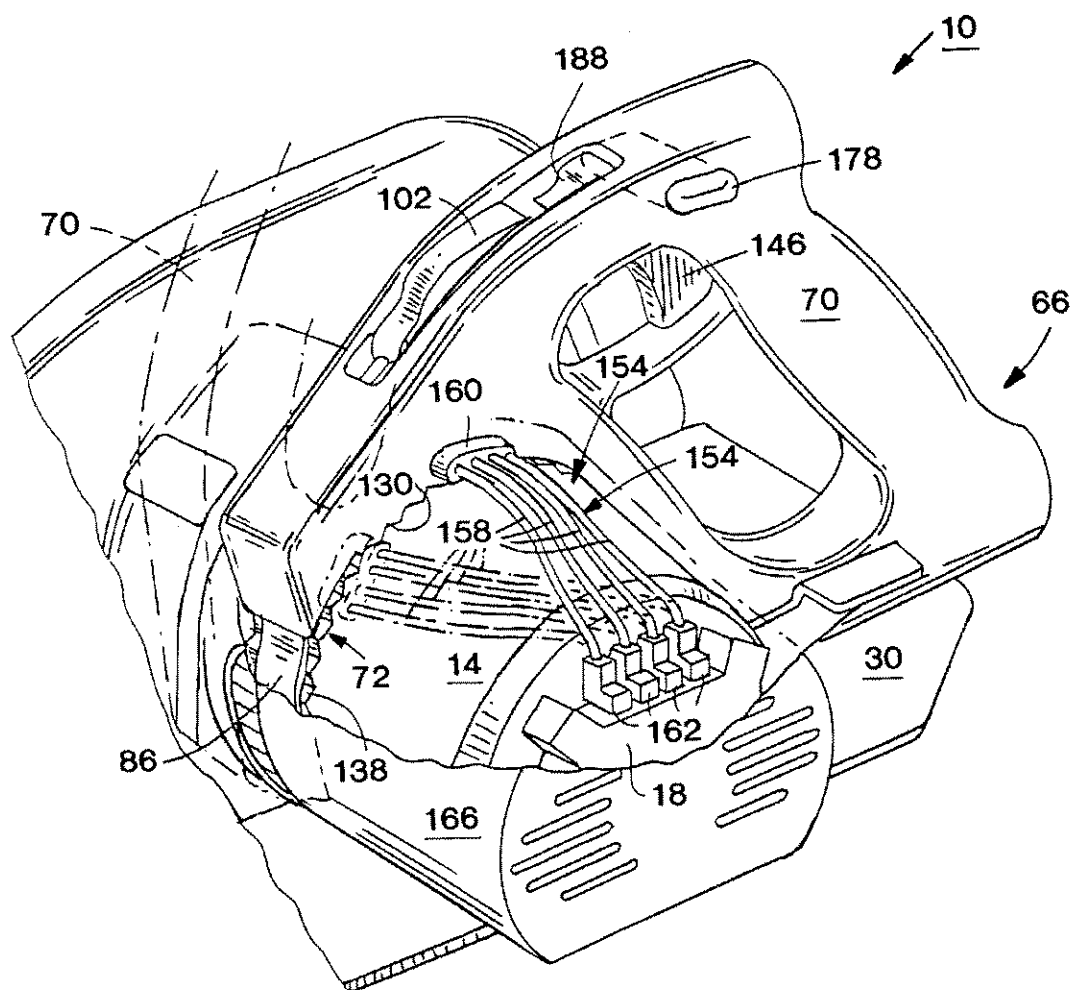


FIG. 3

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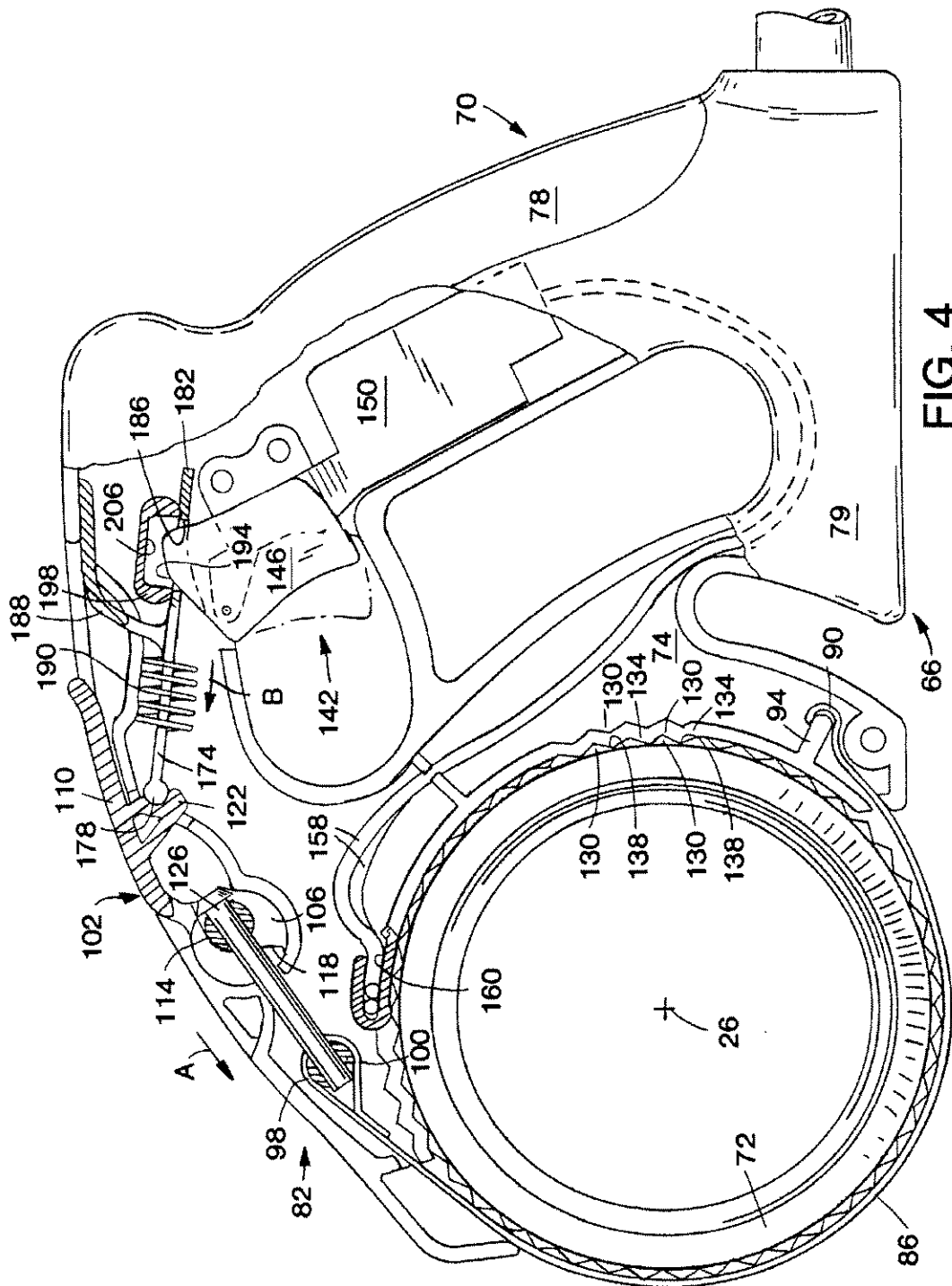
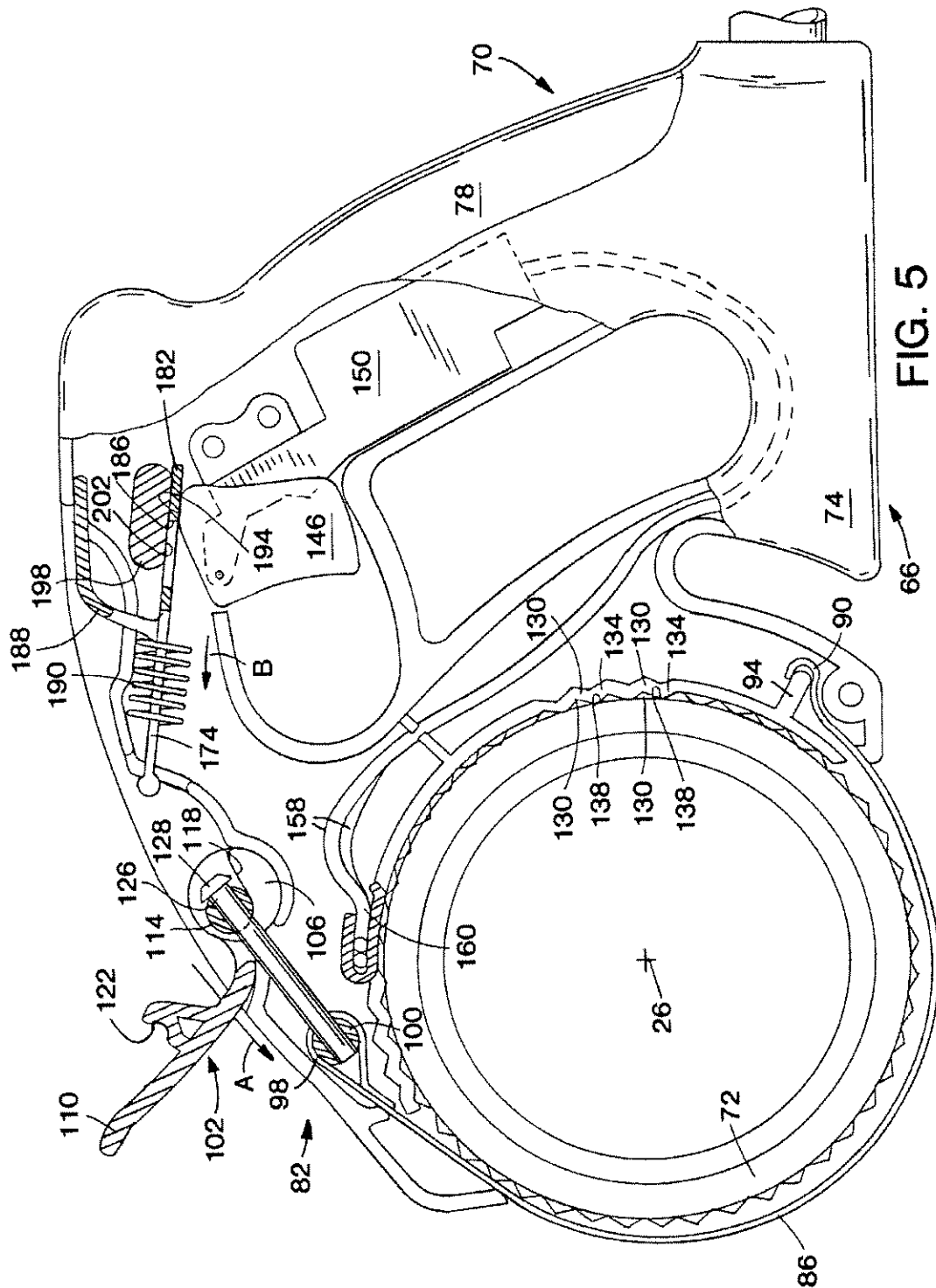


FIG. 4



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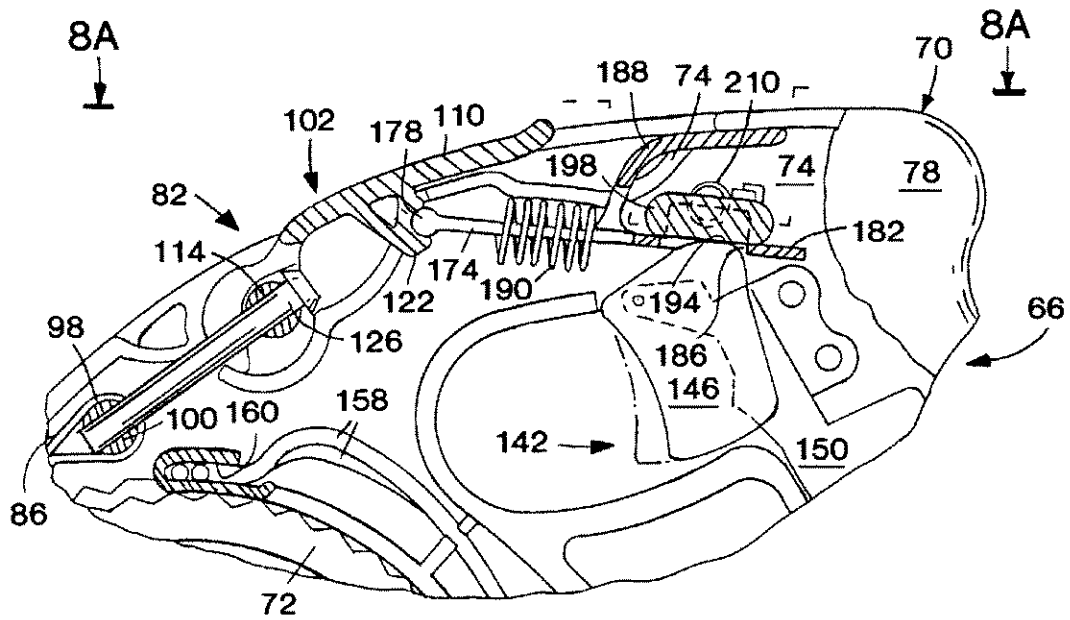
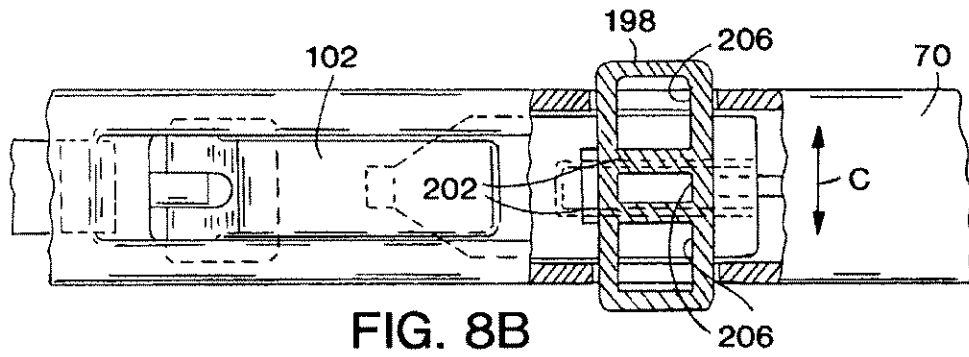
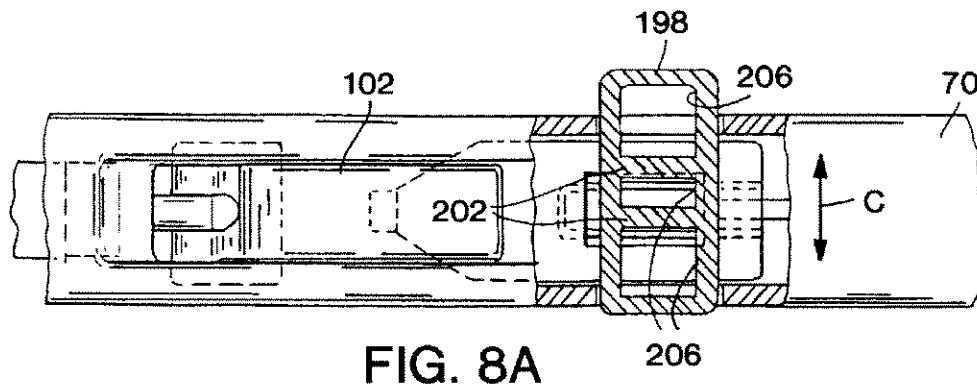


FIG. 6

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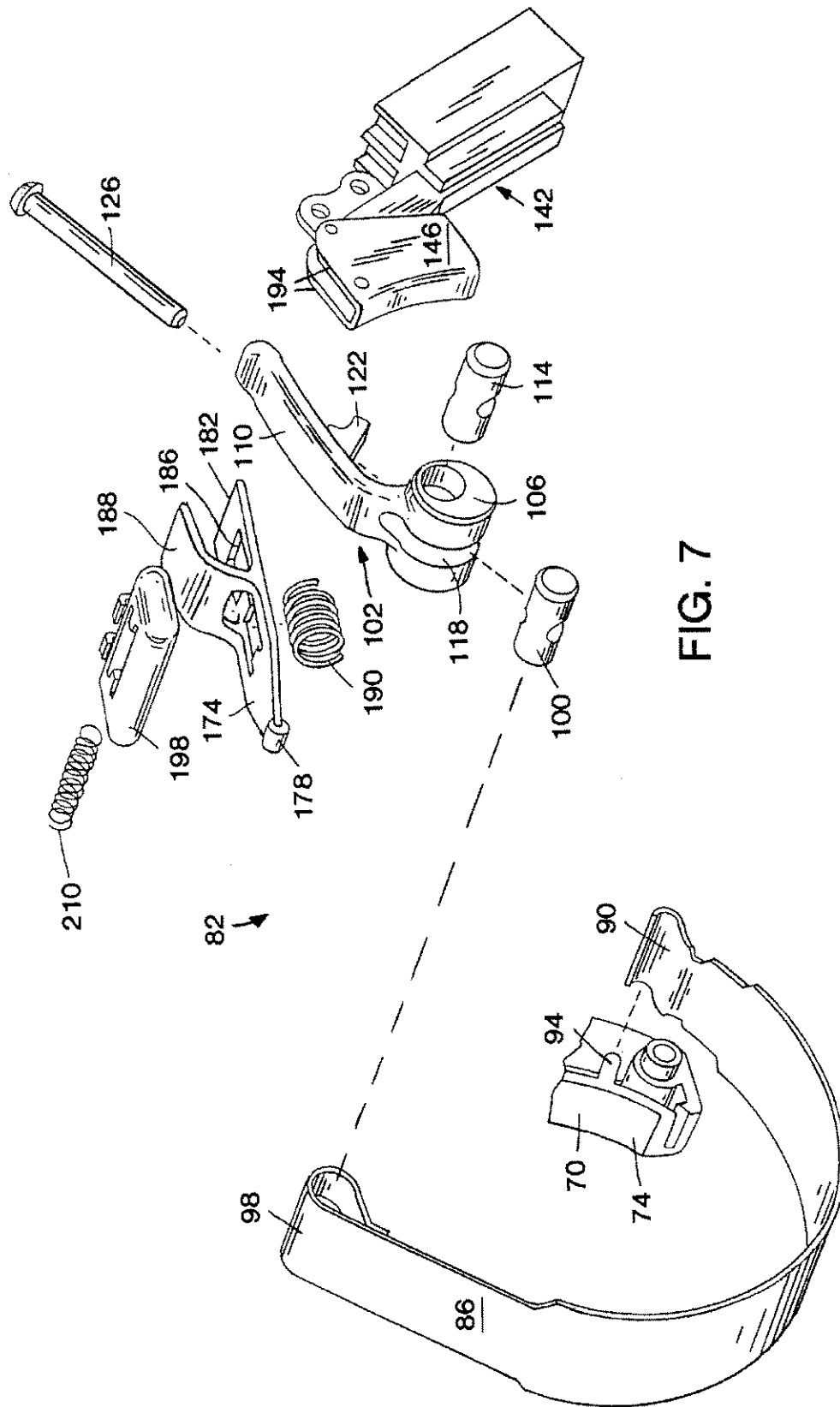


FIG. 7

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MOVABLE HANDLE FOR A POWER TOOL**BACKGROUND OF THE INVENTION**

The present invention relates to power tools and, more particularly, to a handle arrangement for power tools.

A power tool, such as a circular saw, generally includes a housing supporting a motor which rotatably drives a tool element, such as a saw blade. Typically, an operator's handle is integrally formed with the housing. In a circular saw, a shoe plate supports the saw on the surface of a workpiece.

In some circular saws, the housing is adjustable relative to the shoe plate to change the depth of cut of the saw blade. For example, the housing may pivot relative to the shoe plate about an axis adjacent the front of the shoe plate (front pivot depth adjustment) or about an axis adjacent the rear of the shoe plate (rear pivot depth adjustment). In another construction, the shoe plate is slidably lowered and raised relative to the housing (drop shoe depth adjustment). In each of these depth adjustment arrangements, when the depth of cut of the saw blade is adjusted, the position and/or orientation of the handle relative to the workpiece is also adjusted.

U.S. Pat. No. 4,516,324 discloses a modular housing system for a circular saw. The circular saw includes a single, one-piece housing having an interface portion which interchangeably mounts either a pivot adjust subassembly or a vertical (drop shoe) adjust subassembly for changing the depth of cut of the circular saw. The main handle can have either a "push handle" configuration or a "top handle" configuration. The selected handle component is slipped onto the one-piece field case and secured by fasteners.

SUMMARY OF THE INVENTION

One of the problems with a circular saw including an operator's handle that is integrally formed with the housing, is that, in some cutting operations, the operator may prefer a "push handle" to a "top handle" or vice versa. However, the operator cannot adjust the handle to the desired position relative to the housing.

Another problem with a circular saw with an integral handle is that, when the depth of cut of the saw blade is adjusted, the handle position and orientation also changes. The resulting handle position is often uncomfortable and is seldom the optimal position for operation of the circular saw.

For example, in a circular saw with a front pivot depth adjustment assembly, at full depth of cut, the handle is typically positioned as a "push handle". At a minimum depth of cut, the handle position is changed to a "top handle" position. In a circular saw with a rear pivot depth adjustment assembly, at full depth of cut, the handle must be oriented above a typical "push handle" position because, when the saw is adjusted to a minimum depth of cut, the handle is lowered.

One problem with the handle arrangement disclosed in U.S. Pat. No. 4,516,324 is that the circular saw includes two separate handles. The handle component that is not in use must be stored and may be lost or damaged.

Another problem with the handle arrangement disclosed in U.S. Pat. No. 4,516,324 is that the saw includes a handle that is only a "push handle" or a "top handle" and that is not adjustable between these configurations. Additional fasteners are also required.

The present invention provides a handle arrangement for a power tool that alleviates the problems with the above-described handle arrangements. The invention provides a

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power tool, such as a circular saw, that includes a handle that is movable relative to the motor housing. Preferably, the handle is pivotable about the axis of the saw blade relative to the motor housing.

Also, the invention provides a locking assembly for locking the handle in a position relative to the housing. Preferably, the locking assembly provides a frictional engagement between the handle and the housing and includes a clamping member that releasably applies a clamping force to the housing to lock the handle in a position relative to the housing. Preferably, the locking assembly also provides a positive engagement between the handle and the housing and includes inter-engaging teeth formed on both the handle and the housing.

Further, the invention provides means for connecting the switch to the motor to accommodate movement of the switch with the handle and relative to the motor. Preferably, the connecting means are provided by a wiring arrangement.

In addition, the invention provides interaction between the switch and the locking assembly to prevent inadvertent operation of one when the other is operated. Specifically, the switch preferably cannot be operated when the locking assembly is unlocked, and the locking assembly cannot be unlocked when the switch is connecting the motor to the power source.

One advantage of the present invention is that the handle is movable relative to the housing of the power tool to allow the operator to position the handle as desired for a given cutting operation. As a result, the operator can adjust the handle to a position that is most comfortable and allows the greatest control of the circular saw during cutting operations.

Another advantage of the present invention is that, when the circular saw is adjusted to change the depth of cut of the saw blade, the operator can also adjust the handle to an optimum position for the given cutting operation.

Yet another advantage of the present invention is that the circular saw does not include additional components that must be substituted for one another to change the configuration of the handle or additional fasteners. This reduces the chance that such an additional component is lost or damaged and also eliminates the need to store additional components.

A further advantage of the present invention is that the handle is adjustable to substantially any position between a first position, such as a "push handle" position, and a second position, such as a "top handle" position.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings.

DESCRIPTION OF THE DRAWINGS

FIGS. 1A, 1B and 1C are side views of a power tool embodying the invention and illustrating the adjustment of the handle arrangement.

FIG. 2 is a perspective view of the power tool shown in FIGS. 1A-1C.

FIG. 3 is an enlarged perspective view of a portion of the power tool shown in FIG. 2 with portions cut away.

FIG. 4 is a side partial cross-sectional view of the handle arrangement shown in FIG. 3.

FIG. 5 is a view similar to that shown in FIG. 4 and illustrating the locking assembly in an unlocked condition.

FIG. 6 is an enlarged partial cross-sectional view of a portion of the handle arrangement shown in FIG. 4.

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FIG. 7 is an exploded perspective view of a portion of the handle arrangement shown in FIG. 4.

FIG. 8A is a view taken generally along line 8A—8A in FIG. 6.

FIG. 8B is a view similar to that shown in FIG. 8A and illustrating the shuttle switch in a lateral position.

Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of the construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A power tool embodying the invention is illustrated in FIG. 1A. In the illustrated construction, the power tool is a circular saw 10 and includes a motor housing 14 supporting an electric motor 18 (shown schematically in FIG. 1A). The motor 18 is connectable to a power source and is operable to rotatably drive a tool element, such as a saw blade 22, about an axis 26 to cut a workpiece W.

The circular saw 10 also includes (see FIGS. 1A–1C) a shoe plate 30 connected to the housing 14 for pivotal movement about a pivot axis 34. The shoe plate 30 has a support surface 38 for supporting the circular saw 10 on the surface of the workpiece W. An aperture 42 is defined by the shoe plate 30. A portion of the saw blade 22 extends through the aperture 42 to cut the workpiece W. FIG. 1A illustrates the shoe plate 30 adjusted so that the saw blade 22 is at a maximum depth of cut. FIGS. 1B and 1C illustrate the shoe plate 30 adjusted so that the saw blade 22 is at a minimum depth of cut.

In the illustrated construction, the circular saw 10 includes a front pivot depth adjustment assembly 46 to adjust the depth of cut of the saw blade 22. The depth adjustment assembly 46 includes a pivot member 50 defining the pivot axis 34 and pivotally connecting the shoe plate 30 to the housing 14. As shown in FIG. 1B, a guide member 54 cooperates with a depth adjustment locking member 58 (shown in phantom) to lock the shoe plate 30 in a pivoted position relative to the housing 14 thereby fixing the depth of cut of the saw blade 22. A depth adjustment lever 62 operates the locking member 58 between locked and unlocked positions.

In other constructions (not shown), the circular saw 10 may include, for example, a rear pivot depth adjustment assembly or a drop shoe depth adjustment assembly rather than the front pivot depth adjustment assembly 46. It should be understood that the present invention applies to a circular saw with any type of depth adjustment assembly.

The circular saw 10 also includes (see FIGS. 2–6) a movable handle arrangement 66. The movable handle arrangement 66 includes a main operator's handle member 70 movably supported on a support portion 72 of the housing 14 so that the position of the handle member 70 is adjustable relative to the housing 14. Further, with the depth adjustment assembly 46 locked and the saw blade 22 at a desired depth of cut, the handle member 70 is adjustable relative to the shoe plate 30 and relative to the surface of the workpiece W (as shown in the change of position between FIGS. 1B and 1C).

In the illustrated construction, the handle member 70 has (see FIGS. 4–6) opposite handle halves 74 and a rearward

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grip member 78. Further, in the illustrated construction, the handle member 70 is supported to be pivotable about the axis 26 of the saw blade 22 relative to the housing 14. However, in other constructions (not shown), the handle member 70 may be pivotable about an axis that is generally parallel to the axis 26. Also, in yet other constructions (not shown), the handle member 70 may be slidable along an axis normal to the axis 26 relative to the housing 14.

The circular saw 10 also includes (see FIGS. 3–7) a locking assembly 82 to fix the handle member 70 on the support portion 72 of the housing 14 in a pivoted position relative to the housing 14. As explained in more detail below, the locking assembly 82 is operable between a locked condition (shown in FIGS. 4 and 6), in which the handle member 70 is fixed in a position relative to the housing 14, and an unlocked condition (shown in FIG. 5), in which the position of the handle member 70 relative to the housing 14 is adjustable.

The locking assembly 82 includes (see FIGS. 3–7) a locking member 86 which, in the illustrated construction, is a clamping band movably supported on the handle member 70 to releasably apply a clamping force to the support portion 72 of the housing 14. As shown in FIGS. 4 and 5, one end 90 of the locking member 86 is fixed to a stud 94 formed on the handle member 70. The other end 98 of the locking member 86 supports a through pin 100 and is movably connected to the handle member 70, as explained in more detail below. The handle member 70 and the locking member 86 are connected about the support portion 72 of the housing 14.

The locking assembly 82 also includes (see FIGS. 3–7) an actuating member 102 for moving the locking member 86 between a locked position and an unlocked position corresponding to the locked condition and the unlocked condition, respectively, of the locking assembly 82. The actuating member 102 is pivotably supported on the handle member 70 and includes a cam-shaped portion 106 and a lever portion 110. A tapped pin 114 is supported off-center in the cam-shaped portion 106, and an annular opening 118 is formed in the cam-shaped portion 106. A tab 122 extends from the lower surface of the lever portion 110.

To movably connect the end 98 of the locking member 86 to the handle member 70, the locking assembly 82 also includes a threaded pin 126 which engages the through pin 100 connected to the end 98 of the locking member 86. The threaded pin 126 also extends through the tapped pin 114 supported in the cam-shaped portion 106 of the actuating member 102. The annular opening 118 accommodates pivoting movement of the actuating member 102 relative to the threaded pin 126.

To move the locking member 86 between the locked and unlocked positions, the actuating member 102 is pivoted, moving the threaded pin 126 and the end 98 of the locking member 86. As the actuating member 102 is moved from the locked position (shown in FIG. 4) to the unlocked position (shown in FIG. 5), the threaded pin 126 is moved in the direction of arrow A. The locking member 86 is thus moved to the unlocked position (as shown in FIG. 5) and does not apply a clamping force to the support portion 72 to fix the handle member 70 in position relative to the housing 14.

To move the locking member 86 to the locked position, the actuating member 102 is moved from the unlocked position (shown in FIG. 5) to the locked position (shown in FIG. 4) causing the threaded pin 126 to be in the direction opposite to arrow A. The locking member 86 is thus moved to the locked position (shown in FIG. 4) and applies a clamping force to the support portion 72 of the housing 14.

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In the unlocked position (shown in FIG. 5), the threaded pin 126 is adjustable to change the clamping force applied by the locking member 86 when the locking member 86 is in the locked position. With the actuating member 102 in the unlocked position, the exposed end 128 of the threaded pin 126 is accessible by the operator to threadably loosen or tighten the locking member 86. This adjustment of the locking member 86 may be necessary due to manufacturing tolerances or may become necessary due to wear of the movable handle arrangement 66.

The locking assembly 82 also includes (see FIGS. 3-5) inter-engaging teeth 130 formed on the support portion 72 of the housing 14 and on the handle member 70. The inter-engaging teeth 130 provide a plurality of complementary locking projections 134 and locking recesses 138 formed on the support portion 72 of the housing 14 and on the handle member 70. As shown in FIG. 3, the clamping force applied by the locking member 86 to the housing 14 causes close engagement of the inter-engaging teeth 130. As shown in FIG. 5, release of the clamping force allows the inter-engaging teeth 130 to be disengaged and moved relative to each other.

In the preferred embodiment, the locking assembly 82 provides both a frictional engagement, through the clamping force applied by locking member 86 to the support portion 72 of the housing 14, and a positive engagement, through the inter-engaging teeth 130. In other constructions (not shown), however, the locking assembly 82 may only provide either a frictional engagement or a positive engagement.

For example, the locking assembly 82 may include only the frictional engagement provided by a locking member, similar to the locking member 86, applying a clamping force to the support portion of the housing 14. Alternatively, the locking assembly 82 may provide only the positive engagement, such as by a locking projection that is engageable with a locking recess to fix the handle member 70 in a position relative to the housing 14. Such a positive engagement could be provided by a detent assembly between the handle member 70 and the support portion 72 of the housing 14 with locking recesses corresponding to respective positions of the handle member 70 relative to the housing 14.

The circular saw 10 also includes (see FIGS. 3-7) a switch assembly 142 for selectively connecting the motor 18 to the power source to energize the motor 18. The switch assembly 142 is operable between an unoperated condition, in which the motor 18 is not connected to the power source, and an operated condition, in which the motor 18 is connected to the power source. The switch assembly 142 includes a depressable trigger 146 connected to an on/off switch 150. In the illustrated construction, the trigger 146 and the switch 150 are mounted for movement with the handle member 70 and relative to the motor 18.

The circular saw 10 also includes means for connecting the switch 150 to the motor 18. The connecting means accommodates movement of the switch 150 relative to the motor 18 so that, in any position of the handle member 70 relative to the housing 14, the switch 150 is operable to selectively connect the motor 18 to the power source.

In the illustrated construction, the connecting means includes a wiring arrangement 154 (see FIGS. 3-5) to electrically connect the switch 150 to the motor 18. The wiring arrangement 154 includes wires 158 extending through a narrow opening 160 in the handle member 70 and connected to the motor 18 by respective connectors 162. The wiring arrangement 154 includes an amount of wire 158 sufficient to accommodate movement of the switch 150 to

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the extreme pivoted positions (shown in solid and phantom lines in FIG. 3) of the handle member 70 relative to the housing 14. The narrow opening 160 limits the movement of one end of the wires 158 thereby locating the wires 158 during movement of the handle member 70. The connectors 162 limit the movement of other end of wires 158.

In another construction (not shown), the connecting means may include a fixed first conductor mounted on the housing 14 and electrically connected to the motor 18. The first conductor extends along the path of movement of the handle member 70. In this construction, the connecting means also includes a movable second conductor fixed to the handle member 70 and electrically connected to the switch 150. The second conductor is movably connected to the first conductor and moves along the first conductor to thereby maintain the electrical connection between the switch 150 and the motor 18 at any position of the handle member 70 relative to the housing 14.

In yet another construction (not shown), the connecting means may include a remote transmitter and sensor combination to connect the switch 150 to the motor 18. In this construction, the transmitter is fixed to and moves with the handle member 70. The transmitter transmits a signal based on the condition of the switch 150, for example, an "ON" signal or an "OFF" signal. The sensor or receiver is mounted on the housing 14 and electrically connected to the motor 18. The sensor senses the transmitted signal and, if, for example, the "ON" signal is transmitted, connects the motor 18 to the power source. In this construction, the power source is directly connectable to the motor 18, rather than being connected through the switch 150.

A cover 166 is positioned over the motor 18 and the connecting means. In the illustrated construction, the cover 166 includes a channel 170 that accommodates movement of the wires 156 between the extreme pivoted positions (shown in solid and phantom lines in FIG. 3). The channel 170 also insures that the wiring arrangement 154 is protected and not damaged during movement of the handle member 70 relative to the housing 14.

The circular saw 10 also includes (see FIGS. 4-7) means for preventing the switch assembly 142 from connecting the motor 18 to the power source when the locking assembly 82 is in the unlocked condition. Further, the circular saw 10 includes means for preventing the locking assembly 82 from being operated from the locked condition to the unlocked condition when the switch assembly 142 is in the operated condition. The locking assembly 82 and the switch assembly 142 interact to prevent unintentional operation of one assembly when the other assembly is being operated.

The preventing means are provided by a locking plate 174 which interacts with both the locking assembly 82 and the switch assembly 142. The locking plate 174 includes an end 178 for engagement with the tab 122 of the actuating member 102. At the other end, the locking plate 174 includes a blocking portion 182 and an aperture 186. A depressable button 188 is connected to the locking plate 174. The button 188 includes an elongated portion to provide a debris barrier. A spring member 190 biases the locking plate 174 toward engagement with the actuating member 102 (in the direction of arrow B in FIGS. 4 and 5).

As shown in FIG. 5, with the locking assembly 82 in the unlocked condition, the locking plate 174 is moved by the spring member 190 in the direction of arrow B to a position in which the blocking portion 182 engages an upper portion 194 of the trigger 146. In this position, movement of the trigger 146 is prevented, thereby preventing the switch 150 from connecting the motor 18 to the power source.

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During movement of the actuating member 102 to the locked position, the tab 122 engages the end 178 and moves the locking plate 174 in the direction opposite to arrow B. Alternatively, the operator depresses the button 188 to move the locking plate 174. Once the actuating member 102 is in the locked position, the end 178 engages in the recess formed on the tab 122.

As shown in FIG. 4, with the locking assembly 82 in the locked condition, the locking plate 174 is in a position in which the upper portion 194 of the trigger 146 is movable into the aperture 186. In this position, the locking plate 174 does not block movement of the trigger 146 and does not prevent the switch 150 from connecting the motor 18 to the power source.

In order to move the actuating member 102 to the unlocked position, the locking plate 174 must be moved in the direction opposite to arrow B. To move the locking plate 174, the operator depresses the button 188, disengaging the end 178 from recess formed on the tab 122. In the illustrated construction, the actuating member 102 cannot be moved to the unlocked position without the operator depressing the button 188. This reduces the likelihood that the actuating member 102 can be accidentally moved to the unlocked position and that the locking assembly 82 can be accidentally released.

In another construction (not shown), the locking plate 174 does not include the button 188. An unlocking force applied by the operator to move the actuating member 102 to the unlocked position causes the tab 122 to move the locking plate 174 in the direction opposite to arrow B. In such a construction, the configuration of the tab 122 would ensure that the required unlocking force is much greater than a force that would be applied if, for example, the operator accidentally pulled on the actuating member 102. This construction also reduces the likelihood of the locking assembly 82 being accidentally unlocked.

In either construction, however, when the trigger 146 is depressed (as shown in solid lines in FIG. 4), the upper portion 194 of the trigger 146 engages the forward wall of the aperture 186, and the locking plate 174 is prevented from moving in the direction opposite to arrow B. Thus, the locking plate 174 provides a means for preventing the locking assembly 82 from being moved from the locked condition to the unlocked condition when the switch assembly 142 is in the operated condition.

With the trigger in the unoperated condition (as shown in phantom lines in FIG. 4), the upper portion 194 of the trigger 146 does not engage the forward wall of the aperture 186. The locking plate 174 can be moved in the direction opposite to arrow B, and the actuating member 102 can be moved to the unlocked position (shown in FIG. 5).

In other constructions (not shown), the preventing means may be provided by other mechanical interaction between the locking assembly 82 and the switch assembly 142. For example, the preventing means may be provided by direct interaction (not shown) between the trigger 146 and the actuating member 102 without an additional component such as the locking plate 174.

In yet other constructions, the preventing means may be provided by non-mechanical means, such as by additional electrical switches which must be operated to enable operation of the locking assembly 82 and/or the switch assembly 142. For example, the locking assembly 82 can include a switch (not shown) electrically connected to the switch 150. This additional switch would prevent the switch 150 from connecting the motor 18 to the power source when the locking assembly 82 is in the unlocked condition.

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In the illustrated construction, the switch assembly 142 also includes (see FIGS. 3-7, 8A and 8B) a shuttle switch 198 for further preventing unintentional operation of the trigger 146, thereby further preventing unintentional operation of the switch 150 and the motor 18. The shuttle switch 198 is supported for lateral movement (in the direction of arrow C in FIGS. 8A and 8B) by the handle member 70. The shuttle switch 198 includes (see FIGS. 8A and 8B) two ribs 202 and defines three pockets 206. A biasing member 210 (see FIG. 6) biases the shuttle switch 198 to a centered position (as shown in FIG. 8A).

With the shuttle switch 198 in the centered position (shown in FIG. 8A), the upper portion 194 of the trigger 146 contacts the ribs 202, preventing the switch 150 from connecting the motor 18 to the power source. To operate the switch 150, the shuttle switch 198 must first be moved laterally (in the direction of arrow C in FIGS. 8A and 8B) against the force of the biasing member 210. With the shuttle switch 198 in a lateral position (such as that shown in FIG. 8B), the upper portion 194 of the trigger 146 does not contact the ribs 202 but passes into the pockets 206 defined between the ribs 202. The trigger 146 can thus operate the switch 150 to connect the motor 18 to the power source. It should be understood that the shuttle switch 198 can also be to a lateral position opposite to that shown in FIG. 8B to allow movement of the trigger 146.

Movement of the shuttle switch 198 to a lateral position (such as that shown in FIG. 8B) does not affect operation of the trigger 146 when the locking assembly 82 is in the unlocked condition (as shown in FIG. 5). Further, with the locking assembly 82 in the locked condition, the shuttle switch 198 must also be moved to the position shown in FIGS. 4 and 8B to allow the trigger 146 to be operated.

In operation, the operator selects the desired position of the handle member 70 relative to the housing 14 and ensures that the locking assembly 82 is in the locked condition as shown in FIGS. 1A, 2 and 4. The operator then operates the circular saw 10 to cut the workpiece W.

When the operator wants to change the position of the handle member 70 relative to the housing 14, for example, when the depth of cut of the saw blade 22 is adjusted, the operator first moves the switch assembly 142 to the unoperated condition by releasing the trigger 146.

The operator can then move the locking assembly 82 to the unlocked condition. The button 188 is depressed, and the actuating member 102 is moved to the unlocked position (as shown in FIG. 5) so that the locking member 86 does not apply a clamping force to the support portion 72 of the housing 14 and the inter-engaging teeth 130 are disengaged. The handle member 70 is then moved to the desired position relative to the housing 14, and the locking assembly 82 is moved to the locked condition. The locking member 86 applies the clamping force to the support portion 72 of the housing 14, and the inter-engaging teeth 130 are engaged. To continue cutting operations, the operator then moves the shuttle switch 198 to a lateral position (such as that shown in FIG. 8B), and depresses the trigger 146 to operate the motor 18 and cut the workpiece W.

As shown in FIGS. 1A-1C, the operator can adjust the handle member 70 after the depth of cut of the saw blade 22 has been adjusted to maintain a "push handle" orientation (illustrated in FIGS. 1A and 1C). The operator can also adjust the position of the handle member 70 to provide additional comfort to the operator. For example, if the operator is cutting a workpiece W that is positioned lower than the operator's waist, the operator might prefer a top

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handle position and may thus move the handle member 70 upwardly. Alternatively, in some cutting operations, the operator may prefer the "push handle" orientation to the "top handle" orientation. The operator can then move the handle member 70 from the higher "top handle" orientation to the lower "push handle" orientation.

Various features of the invention are set forth in the following claims.

We claim:

1. A circular saw comprising:

a motor operable to rotatably drive a saw blade about an axis;

a motor housing supporting said motor;

a handle supported by said housing for movement relative to said housing;

a locking assembly for locking said handle in a position relative to said housing; and

a switch assembly supported on said handle for movement with said handle, said switch assembly being electrically connectable to said motor and operable to selectively connect said motor to a power source.

2. The circular saw as set forth in claim 1 wherein said locking assembly is operable between a locked condition, in which said handle is fixed in a position relative to said housing, and an unlocked condition, in which said handle is movable relative to said housing.

3. The circular saw as set forth in claim 2 wherein said locking assembly, in the unlocked condition, prevents said switch assembly from connecting said motor to the power source.

4. The circular saw as set forth in claim 3 wherein said switch assembly includes a trigger, and wherein, when said locking assembly is in the unlocked condition, a portion of said trigger is engaged to prevent said switch assembly from connecting said motor to the power source.

5. The circular saw as set forth in claim 2 wherein said switch assembly is operable between an unoperated condition, in which said motor is not connected to the power source, and an operated condition, in which said motor is connected to the power source, and wherein said switch assembly, in the operated condition, prevents said locking assembly from being operated from the locked condition to the unlocked condition.

6. The circular saw as set forth in claim 5 wherein said locking assembly includes an actuating member, and wherein, when said switch assembly is in the operated condition, a portion of said actuating member is engaged to prevent said locking assembly from being operated from the locked condition to the unlocked condition.

7. The circular saw as set forth in claim 1 wherein said locking assembly includes

at least one locking protrusion formed on one of said handle and said housing, and

at least one locking recess formed on the other of said handle and said housing, and wherein said locking protrusion is engageable with said locking recess to fix said handle in a position relative to said housing.

8. The circular saw as set forth in claim 7 wherein said locking assembly includes

a plurality of locking protrusions formed on one of said handle and said housing, and

a plurality of locking recesses formed on the other of said handle and said housing, and wherein said plurality of locking protrusions are engageable with said plurality of locking recesses to fix said handle in a position relative to said housing.

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9. The circular saw as set forth in claim 1 wherein said locking assembly includes

a locking member operable between a locked position, in which said handle is fixed in a position relative to said housing, and an unlocked position, and

an actuating member for operating said locking member between the locked position and the unlocked position.

10. The circular saw as set forth in claim 9 wherein said handle member has an upper surface, and wherein said actuating member is located on said upper surface.

11. The circular saw as set forth in claim 9 wherein said locking member is a clamping member operable to apply, in the locked position, clamping force to one of said housing and said handle to fix said handle in a position relative to said housing.

12. The circular saw as set forth in claim 11 wherein said clamping member is supported on said handle to selectively apply clamping force to said housing.

13. The circular saw as set forth in claim 12 wherein said handle has first and second ends, wherein said clamping member has opposite ends, one opposite end connected to said first end of said handle and the other opposite end movably connected to said second end of said handle, and wherein said other opposite end of said clamping member is movable relative to said second end of said handle so that said clamping member selectively applies the clamping force to said housing.

14. The circular saw as set forth in claim 13 wherein said locking assembly further includes

a plurality of locking protrusions formed on one of said handle and said housing, and

a plurality of locking recesses formed on the other of said handle and said housing, and wherein, when said clamping member applies clamping force to said housing, said plurality of locking protrusions is engageable with said plurality of locking recesses to fix said handle in a position relative to said housing.

15. The circular saw as set forth in claim 14 wherein said plurality of locking protrusions and said plurality of locking recesses are provided by a plurality of inter-engaging teeth formed on each of said handle and said housing.

16. A circular saw comprising:

a motor operable to rotatably drive a saw blade about an axis;

a motor housing supporting said motor;

a handle supported by said housing for movement relative to said housing;

a switch supported on said handle for movement with said handle, said switch being connectable to said motor and operable selectively connect said motor to a power source; and

means for connecting said switch to said motor to accommodate movement of said switch relative to said motor.

17. The circular saw as set forth in claim 16 wherein said connecting means include a wiring arrangement electrically connecting said switch to said motor and accommodating movement of said switch relative to said motor.

18. The circular saw as set forth in claim 1 wherein said handle is pivotable relative to said housing.

19. The circular saw as set forth in claim 1 wherein said handle is pivotable relative to said housing about a second axis generally parallel to said first-mentioned axis.

20. The circular saw as set forth in claim 1 wherein said handle is pivotable relative to said housing about said axis.

21. The circular saw as set forth in claim 17 wherein said handle is movable relative to said housing between a first

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position and a second position, and wherein said wiring arrangement includes a wire electrically connecting said switch to said motor and having a sufficient length to accommodate movement of said switch relative to said motor when said handle is moved between the first position and the second position. 5

22. The circular saw as set forth in claim 21 wherein said wire includes a connector for connecting said wire to said motor, wherein said wire extends through an opening in said handle, and wherein said connector and said opening limit movement of said wire when said handle is moved between the first position and the second position. 10

23. The circular saw as set forth in claim 21 and further comprising a cover positioned said motor and said connecting means, said cover defining a channel accommodating movement of said wire when said handle is moved between the first position and the second position. 15

24. A power tool comprising:

a housing;

a motor supported by said housing and operable to drive a tool element relative to a first axis; 20

a handle supported by said housing for movement relative to said housing about a second axis generally parallel to said first axis, wherein said handle is shaped to be grasped by an operator to provide for movement of said power tool, and wherein said first axis and said second axis are fixed relative to said housing; 25

a switch supported on said handle for movement with said handle, said switch being electrically connectable to said motor and operable to selectively connect said motor to a power source; and 30

a locking assembly operable between a locked condition, in which said handle is fixed in a pivoted position relative to said housing, and an unlocked condition, in which said handle is pivotable relative to said housing, said locking assembly including a portion engageable with said switch, in the unlocked condition of said locking assembly, to prevent said switch assembly from connecting said motor to the power source. 35 40

25. A circular saw comprising:

a motor operable to rotatably drive a saw blade about an axis;

a motor housing supporting said motor;

a main handle supported by said housing for movement relative to said housing, said handle being graspable by an operator to provide for movement of said power tool; and 45

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a locking assembly for locking said handle in a position relative to said housing;

wherein said locking assembly is operable between a locked condition, in which said handle is fixed in a position relative to said housing, and an unlocked condition, in which said handle is movable relative to said housing; and wherein said circular saw further comprises:

a switch supported on said handle for movement with said handle, said switch being electrically connectable to said motor and operable to selectively connect said motor to a power source; and means for preventing said switch from connecting said motor to the power source when said locking assembly is in the unlocked condition.

26. A circular saw comprising:

a motor operable to rotatably drive a saw blade about an axis;

a motor housing supporting said motor;

a main handle supported by said housing for movement relative to said housing, said handle being graspable by an operator to provide for movement of said power tool; and

a locking assembly for locking said handle in a position relative to said housing;

wherein said locking assembly is operable between a locked condition, in which said handle is fixed in a position relative to said housing, and an unlocked condition, in which said handle is movable relative to said housing, and wherein said circular saw further comprises:

a switch supported on said handle for movement with said handle, said switch being electrically connectable to said motor and operable to selectively connect said motor to a power source, said switch being operable between an operated condition, in which said motor is connected to the power source, and an unoperated condition, in which said motor is not connected to the power source; and

means for preventing said locking assembly from being operated from the locked condition to the unlocked condition when said switch is in the operated condition.

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(12) **United States Patent**
Zeiler et al.

(10) **Patent No.:** US 6,301,790 B1
(45) **Date of Patent:** Oct. 16, 2001

(54) **MOVABLE HANDLE FOR A POWER TOOL**

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(*) **Notice:** Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
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(21) **Appl. No.:** 09/618,217

(22) **Filed:** Jul. 18, 2000

Related U.S. Application Data

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14, 1998, now Pat. No. 6,108,916.

(51) **Int. Cl.⁷** B23D 45/16

(52) **U.S. Cl.** 30/391; 30/390

(58) **Field of Search** 83/13, 34, 56;
30/122, 319, 388-391

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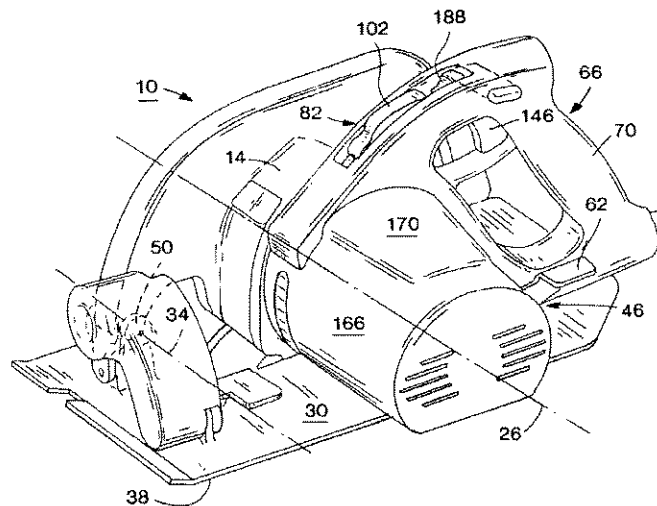
Primary Examiner—Douglas D. Watts

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LLP

(57) **ABSTRACT**

A movable handle for a power tool. The power tool comprises a housing, a motor supported by the housing and operable to drive a tool element about an axis, and a handle supported by the housing for rotation relative to the housing about the axis. Preferably, the power tool is a circular saw. The circular saw further comprises a switch assembly supported on the handle for movement with the handle and means for connecting the switch to the motor to accommodate movement of the switch relative to the motor. The switch assembly is electrically connectable to the motor and selectively connects the motor to a power source, and the connecting means includes a wiring arrangement. The circular saw further comprises a locking assembly for locking the handle in a position relative to the housing. Also, the circular saw preferably comprises means for preventing the switch assembly from connecting the motor to the power source when the locking assembly is in the unlocked condition and means for preventing the locking assembly from being operated from the locked condition to the unlocked condition when the switch assembly is in the operated condition.

30 Claims, 7 Drawing Sheets

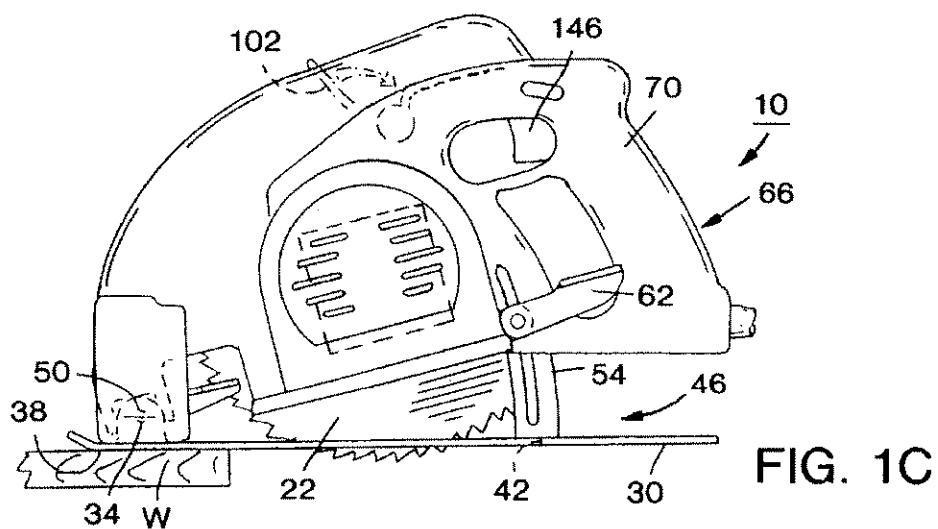
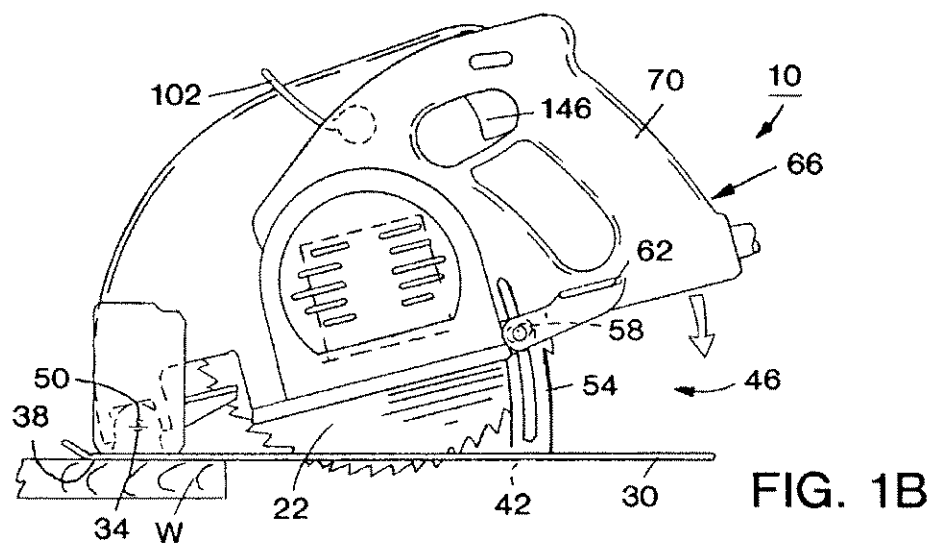
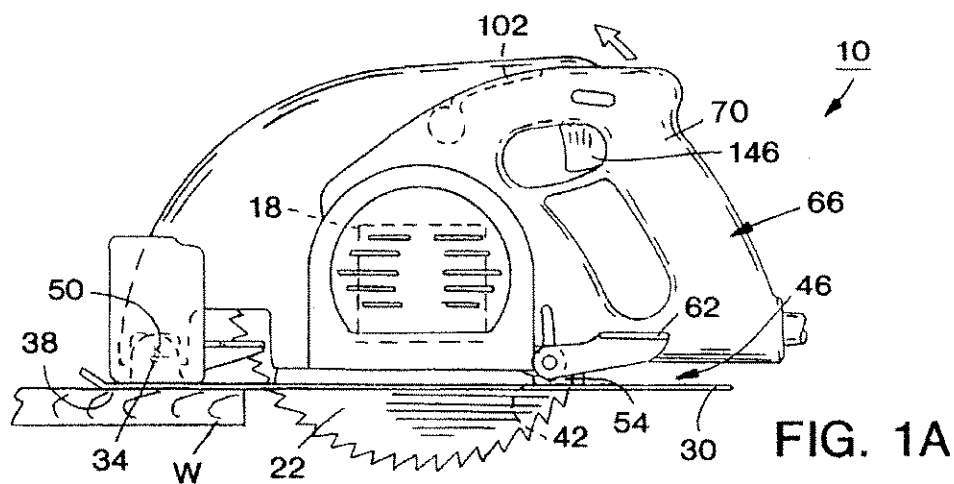


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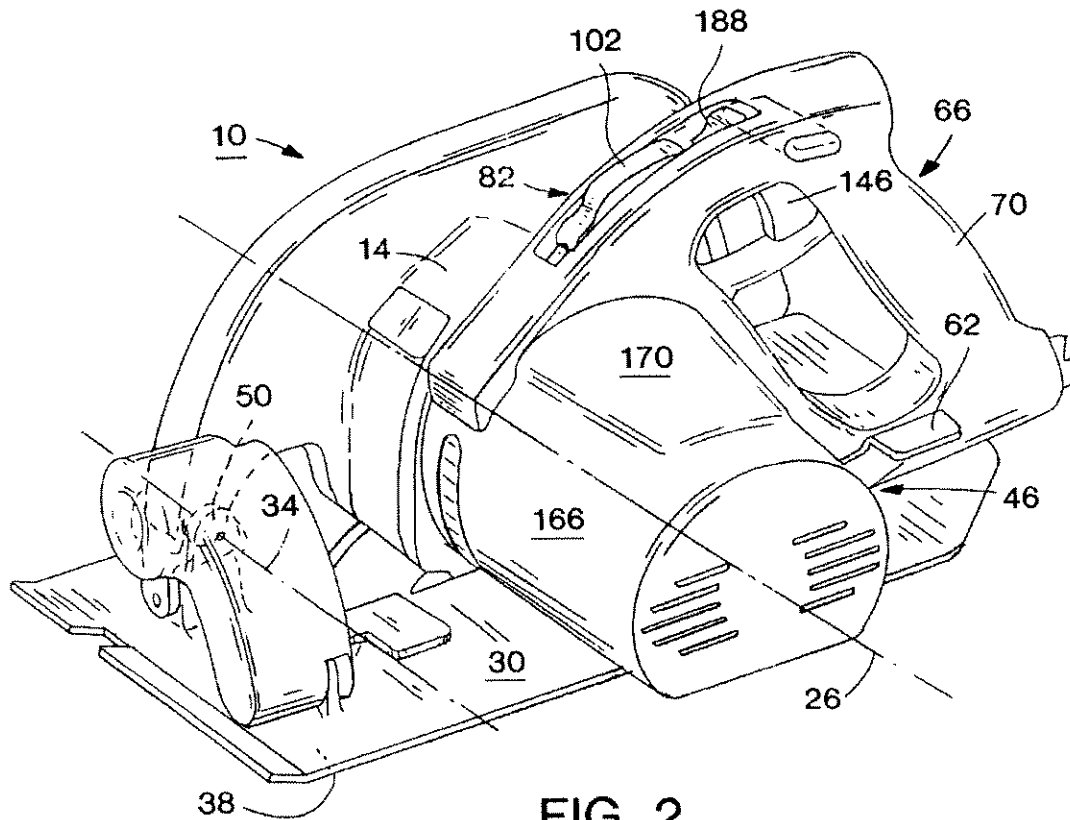


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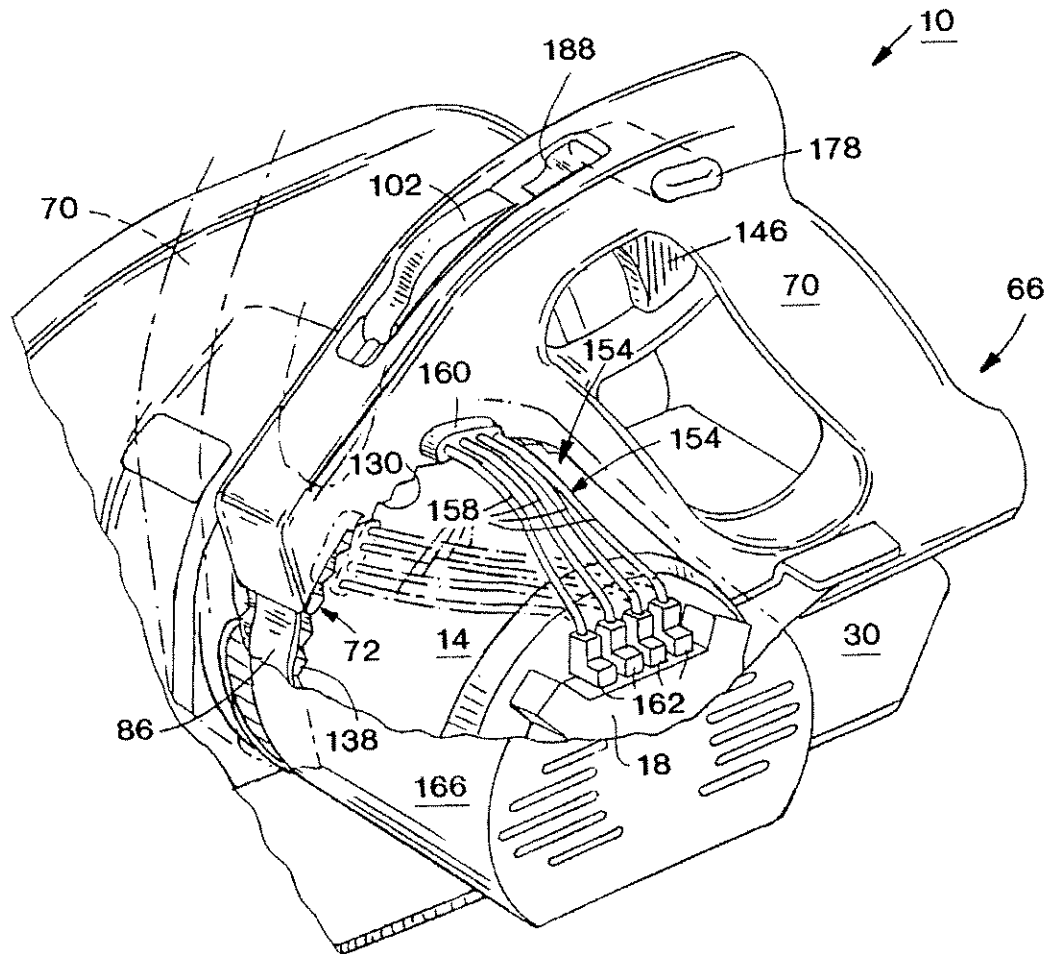


FIG. 3

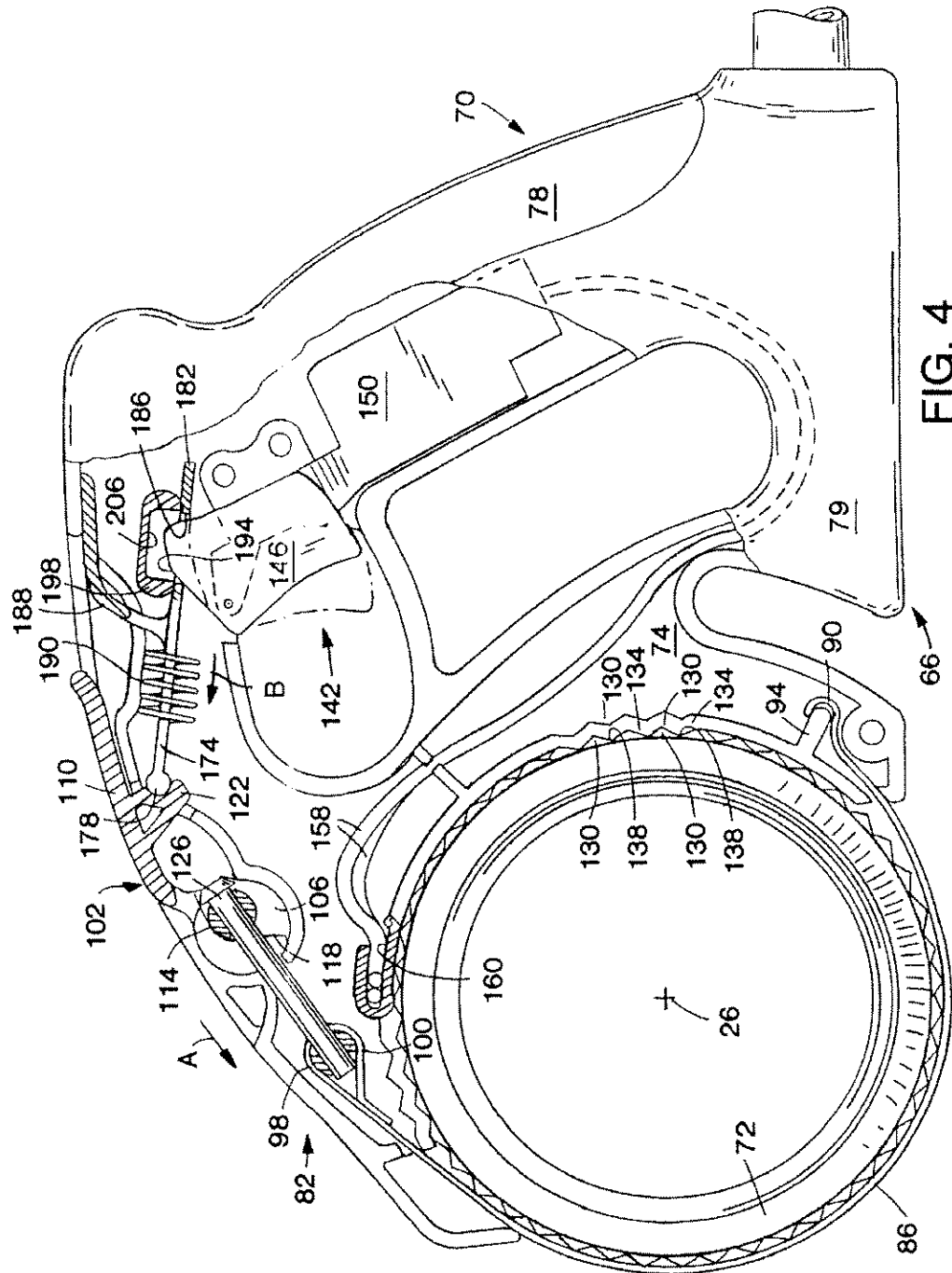
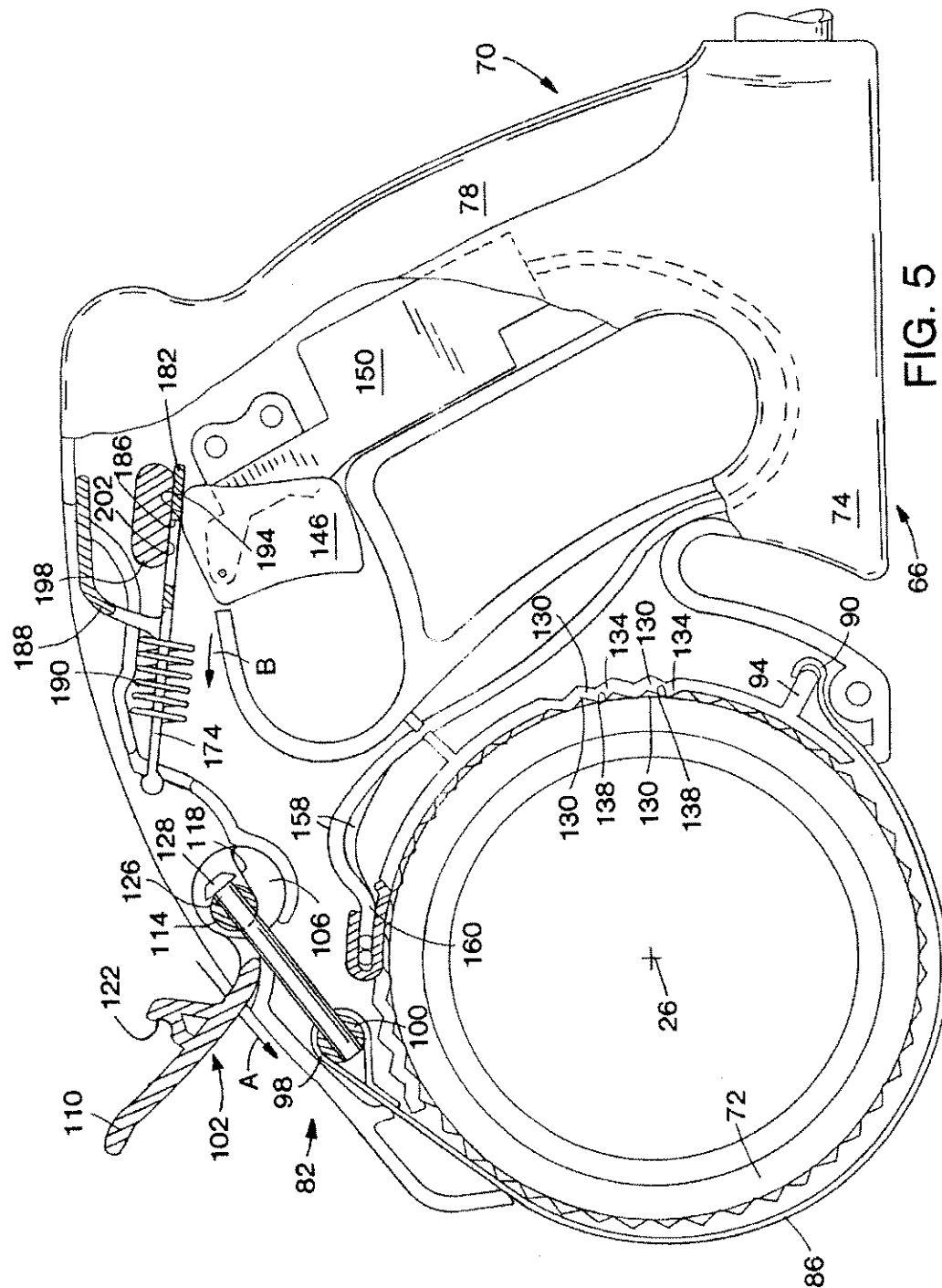


FIG. 4



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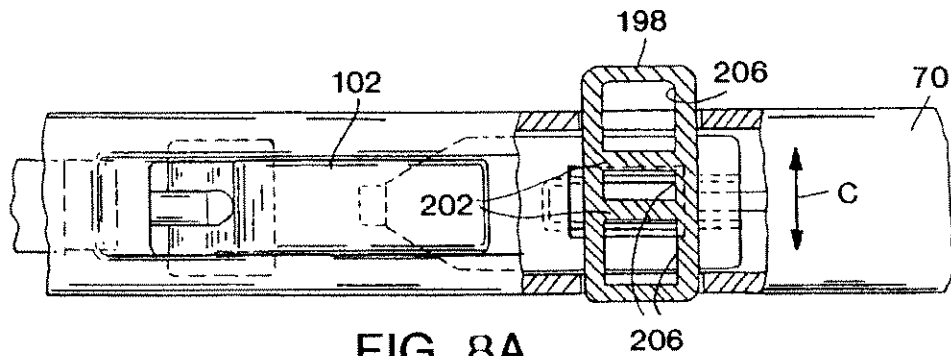


FIG. 8A

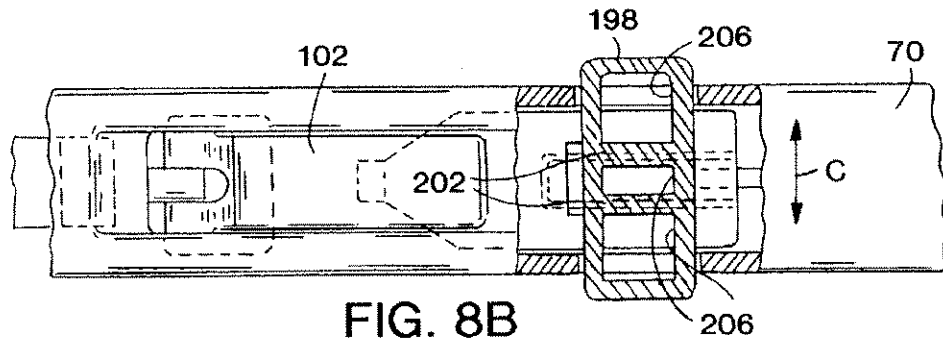


FIG. 8B

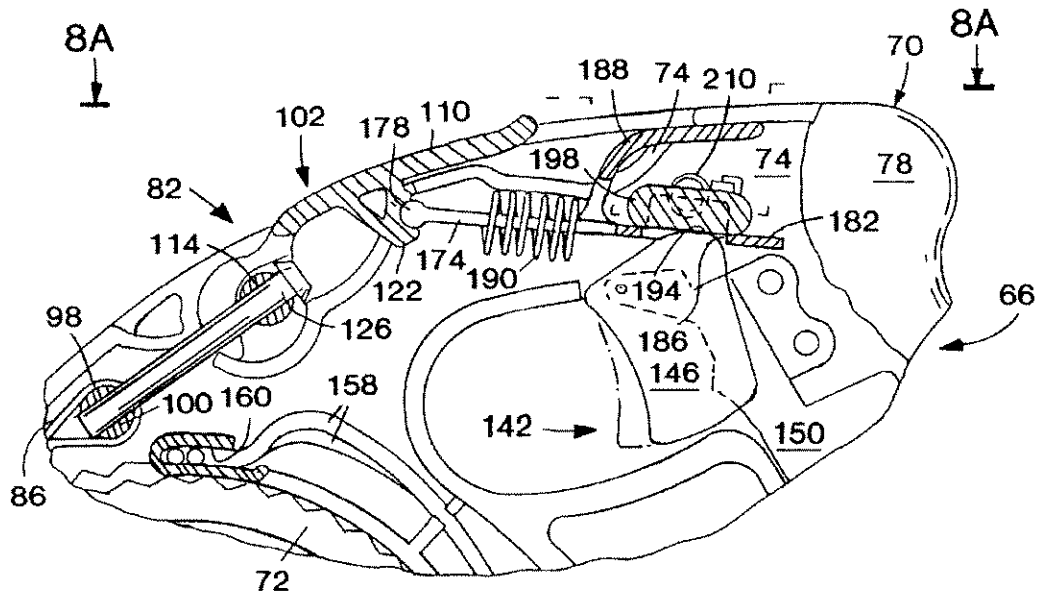


FIG. 6

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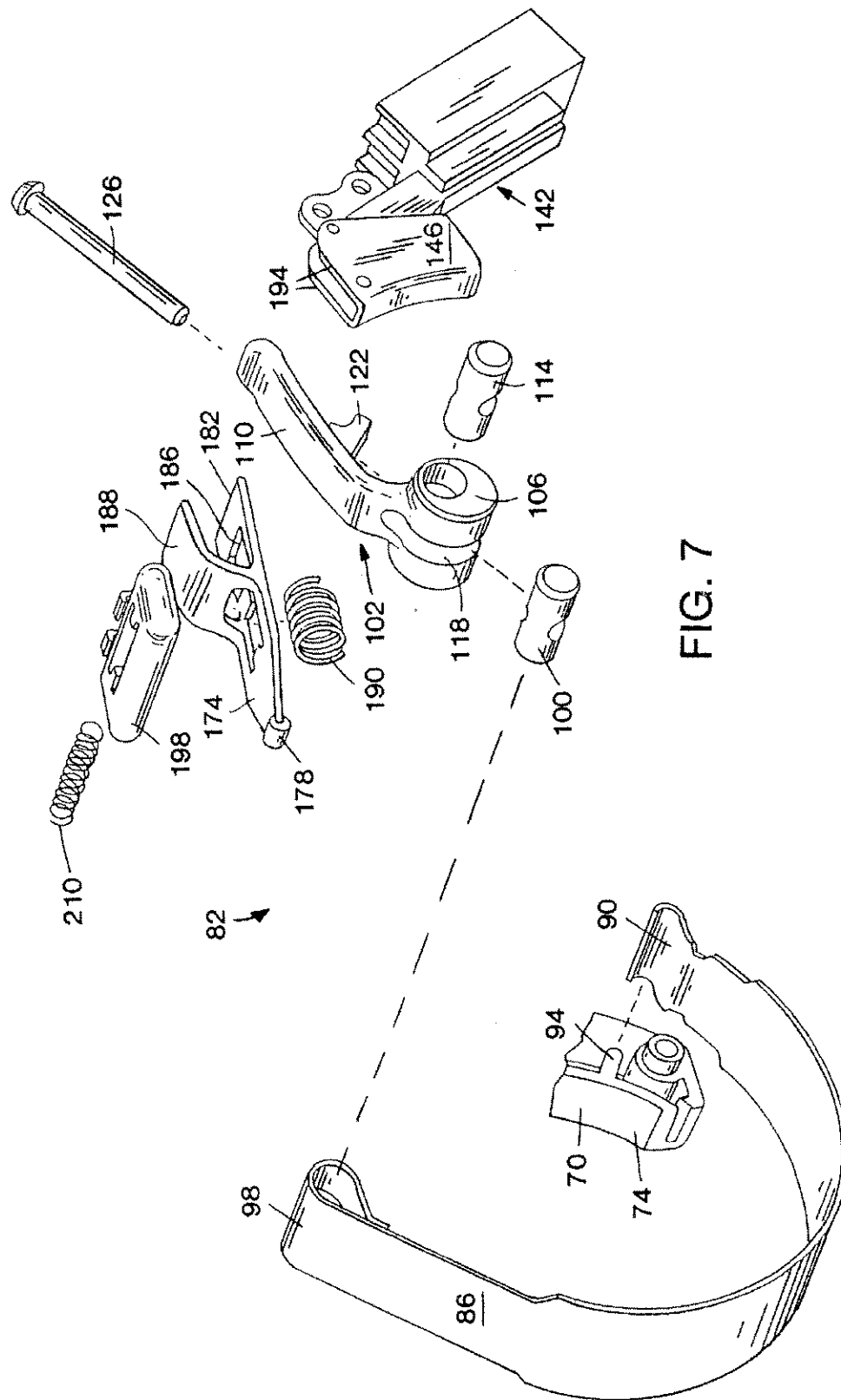


FIG. 7

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MOVABLE HANDLE FOR A POWER TOOL

This application is a continuation of patent application Ser. No. 09/134,626, filed on Aug. 14, 1998 now U.S. Pat. No. 6,108,916.

BACKGROUND OF THE INVENTION

The present invention relates to power tools and, more particularly, to a handle arrangement for power tools.

A power tool, such as a circular saw, generally includes a housing supporting a motor which rotatably drives a tool element, such as a saw blade. Typically, an operator's handle is integrally formed with the housing. In a circular saw, a shoe plate supports the saw on the surface of a workpiece.

In some circular saws, the housing is adjustable relative to the shoe plate to change the depth of cut of the saw blade. For example, the housing may pivot relative to the shoe plate about an axis adjacent the front of the shoe plate (front pivot depth adjustment) or about an axis adjacent the rear of the shoe plate (rear pivot depth adjustment). In another construction, the shoe plate is slidably lowered and raised relative to the housing (drop shoe depth adjustment). In each of these depth adjustment arrangements, when the depth of cut of the saw blade is adjusted, the position and/or orientation of the handle relative to the workpiece is also adjusted.

U.S. Pat. No. 4,516,324 discloses a modular housing system for a circular saw.

The circular saw includes a single, one-piece housing having an interface portion which interchangeably mounts either a pivot adjust subassembly or a vertical (drop shoe) adjust subassembly for changing the depth of cut of the circular saw. The main handle can have either a "push handle" configuration or a "top handle" configuration. The selected handle component is slipped onto the one-piece field case and secured by fasteners.

SUMMARY OF THE INVENTION

One of the problems with a circular saw including an operator's handle that is integrally formed with the housing, is that, in some cutting operations, the operator may prefer a "push handle" to a "top handle" or vice versa. However, the operator cannot adjust the handle to the desired position relative to the housing. Another problem with a circular saw with an integral handle is that, when the depth of cut of the saw blade is adjusted, the handle position and orientation also changes. The resulting handle position is often uncomfortable and is seldom the optimal position for operation of the circular saw.

For example, in a circular saw with a front pivot depth adjustment assembly, at full depth of cut, the handle is typically positioned as a "push handle". At a minimum depth of cut, the handle position is changed to a "top handle" position. In a circular saw with a rear pivot depth adjustment assembly, at full depth of cut, the handle must be oriented above a typical "push handle" position because, when the saw is adjusted to a minimum depth of cut, the handle is lowered.

One problem with the handle arrangement disclosed in U.S. Pat. No. 4,516,324 is that the circular saw includes two separate handles. The handle component that is not in use must be stored and may be lost or damaged.

Another problem with the handle arrangement disclosed in U.S. Pat. No. 4,516,324 is that the saw includes a handle that is only a "push handle" or a "top handle" and that is not

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adjustable between these configurations. Additional fasteners are also required.

The present invention provides a handle arrangement for a power tool that alleviates the problems with the above-described handle arrangements. The invention provides a power tool, such as a circular saw, that includes a handle that is movable relative to the motor housing. Preferably, the handle is pivotable about the axis of the saw blade relative to the motor housing.

Also, the invention provides a locking assembly for locking the handle in a position relative to the housing. Preferably, the locking assembly provides a frictional engagement between the handle and the housing and includes a clamping member that releasably applies a clamping force to the housing to lock the handle in a position relative to the housing. Preferably, the locking assembly also provides a positive engagement between the handle and the housing and includes inter-engaging teeth formed on both the handle and the housing.

Further, the invention provides means for connecting the switch to the motor to accommodate movement of the switch with the handle and relative to the motor. Preferably, the connecting means are provided by a wiring arrangement.

In addition, the invention provides interaction between the switch and the locking assembly to prevent inadvertent operation of one when the other is operated. Specifically, the switch preferably cannot be operated when the locking assembly is unlocked, and the locking assembly cannot be unlocked when the switch is connecting the motor to the power source.

One advantage of the present invention is that the handle is movable relative to the housing of the power tool to allow the operator to position the handle as desired for a given cutting operation. As a result, the operator can adjust the handle to a position that is most comfortable and allows the greatest control of the circular saw during cutting operations.

Another advantage of the present invention is that, when the circular saw is adjusted to change the depth of cut of the saw blade, the operator can also adjust the handle to an optimum position for the given cutting operation.

Yet another advantage of the present invention is that the circular saw does not include additional components that must be substituted for one another to change the configuration of the handle or additional fasteners. This reduces the chance that such an additional component is lost or damaged and also eliminates the need to store additional components.

A further advantage of the present invention is that the handle is adjustable to substantially any position between a first position, such as a "push handle" position, and a second position, such as a "top handle" position.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings.

DESCRIPTION OF THE DRAWINGS

FIGS. 1A, 1B and 1C are side views of a power tool embodying the invention and illustrating the adjustment of the handle arrangement.

FIG. 2 is a perspective view of the power tool shown in Figs. 1A-1C.

FIG. 3 is an enlarged perspective view of a portion of the power tool shown in FIG. 2 with portions cut away.

FIG. 4 is a side partial cross-sectional view of the handle arrangement shown in FIG. 3.

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FIG. 5 is a view similar to that shown in FIG. 4 and illustrating the locking assembly in an unlocked condition.

FIG. 6 is an enlarged partial cross-sectional view of a portion of the handle arrangement shown in FIG. 4.

FIG. 7 is an exploded perspective view of a portion of the handle arrangement shown in FIG. 4.

FIG. 8A is a view taken generally along line 8A—8A in FIG. 6.

FIG. 8B is a view similar to that shown in FIG. 8A and illustrating the shuttle switch in a lateral position.

Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of the construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A power tool embodying the invention is illustrated in FIG. 1A. In the illustrated construction, the power tool is a circular saw 10 and includes a motor housing 14 supporting an electric motor 18 (shown schematically in Fig. 1A). The motor 18 is connectable to a power source and is operable to rotatably drive a tool element, such as a saw blade 22, about an axis 26 to cut a workpiece W.

The circular saw 10 also includes (see Figs. 1A–1C) a shoe plate 30 connected to the housing 14 for pivotal movement about a pivot axis 34. The shoe plate 30 has a support surface 38 for supporting the circular saw 10 on the surface of the workpiece W. An aperture 42 is defined by the shoe plate 30. A portion of the saw blade 22 extends through the aperture 42 to cut the workpiece W. Fig. 1A illustrates the shoe plate 30 adjusted so that the saw blade 22 is at a maximum depth of cut. FIGS. 1B and 1C illustrate the shoe plate 30 adjusted so that the saw blade 22 is at a minimum depth of cut.

In the illustrated construction, the circular saw 10 includes a front pivot depth adjustment assembly 46 to adjust the depth of cut of the saw blade 22. The depth adjustment assembly 46 includes a pivot member 50 defining the pivot axis 34 and pivotally connecting the shoe plate 30 to the housing 14. As shown in Fig. 1B, a guide member 54 cooperates with a depth adjustment locking member 58 (shown in phantom) to lock the shoe plate 30 in a pivoted position relative to the housing 14 thereby fixing the depth of cut of the saw blade 22. A depth adjustment lever 62 operates the locking member 58 between locked and unlocked positions.

In other constructions (not shown), the circular saw 10 may include, for example, a rear pivot depth adjustment assembly or a drop shoe depth adjustment assembly rather than the front pivot depth adjustment assembly 46. It should be understood that the present invention applies to a circular saw with any type of depth adjustment assembly.

The circular saw 10 also includes (see FIGS. 2–6) a movable handle arrangement 66. The movable handle arrangement 66 includes a main operator's handle member 70 movably supported on a support portion 72 of the housing 14 so that the position of the handle member 70 is adjustable relative to the housing 14. Further, with the depth adjustment assembly 46 locked and the saw blade 22 at a desired depth

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of cut, the handle member 70 is adjustable relative to the shoe plate 30 and relative to the surface of the workpiece W (as shown in the change of position between FIGS. 1B and 1C).

In the illustrated construction, the handle member 70 has (see FIGS. 4–6) opposite handle halves 74 and a rearward grip member 78. Further, in the illustrated construction, the handle member 70 is supported to be pivotable about the axis 26 of the saw blade 22 relative to the housing 14. However, in other constructions (not shown), the handle member 70 may be pivotable about an axis that is generally parallel to the axis 26. Also, in yet other constructions (not shown), the handle member 70 may be slidable along an axis normal to the axis 26 relative to the housing 14. The circular saw 10 also includes (see FIGS. 3–7) a locking assembly 82 to fix the handle member 70 on the support portion 72 of the housing 14 in a pivoted position relative to the housing 14. As explained in more detail below, the locking assembly 82 is operable between a locked condition (shown in FIGS. 4 and 6), in which the handle member 70 is fixed in a position relative to the housing 14, and an unlocked condition (shown in FIG. 5), in which the position of the handle member 70 relative to the housing 14 is adjustable.

The locking assembly 82 includes (see FIGS. 3–7) a locking member 86 which, in the illustrated construction, is a clamping band movably supported on the handle member 70 to releasably apply a clamping force to the support portion 72 of the housing 14. As shown in FIGS. 4 and 5, one end 90 of the locking member 86 is fixed to a stud 94 formed on the handle member 70. The other end 98 of the locking member 86 supports a through pin 100 and is movably connected to the handle member 70, as explained in more detail below. The handle member 70 and the locking member 86 are connected about the support portion 72 of the housing 14.

The locking assembly 82 also includes (see FIGS. 3–7) an actuating member 102 for moving the locking member 86 between a locked position and an unlocked position corresponding to the locked condition and the unlocked condition, respectively, of the locking assembly 82. The actuating member 102 is pivotably supported on the handle member 70 and includes a cam-shaped portion 106 and a lever portion 110. A tapped pin 114 is supported off-center in the cam-shaped portion 106, and an annular opening 118 is formed in the cam-shaped portion 106. A tab 122 extends from the lower surface of the lever portion 110.

To movably connect the end 98 of the locking member 86 to the handle member 70, the locking assembly 82 also includes a threaded pin 126 which engages the through pin 100 connected to the end 98 of the locking member 86. The threaded pin 126 also extends through the tapped pin 114 supported in the cam-shaped portion 106 of the actuating member 102. The annular opening 118 accommodates pivoting movement of the actuating member 102 relative to the threaded pin 126.

To move the locking member 86 between the locked and unlocked positions, the actuating member 102 is pivoted, moving the threaded pin 126 and the end 98 of the locking member 86. As the actuating member 102 is moved from the locked position (shown in FIG. 4) to the unlocked position (shown in FIG. 5), the threaded pin 126 is moved in the direction of arrow A. The locking member 86 is thus moved to the unlocked position (as shown in FIG. 5) and does not apply a clamping force to the support portion 72 to fix the handle member 70 in position relative to the housing 14.

To move the locking member 86 to the locked position, the actuating member 102 is moved from the unlocked

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position (shown in FIG. 5) to the locked position (shown in FIG. 4) causing the threaded pin 126 to be in the direction opposite to arrow A. The locking member 86 is thus moved to the locked position (shown in FIG. 4) and applies a clamping force to the support portion 72 of the housing 14.

In the unlocked position (shown in FIG. 5), the threaded pin 126 is adjustable to change the clamping force applied by the locking member 86 when the locking member 86 is in the locked position. With the actuating member 102 in the unlocked position, the exposed end 128 of the threaded pin 126 is accessible by the operator to threadably loosen or tighten the locking member 86. This adjustment of the locking member 86 may be necessary due to manufacturing tolerances or may become necessary due to wear of the movable handle arrangement 66.

The locking assembly 82 also includes (see FIGS. 3-5) inter-engaging teeth 130 formed on the support portion 72 of the housing 14 and on the handle member 70. The inter-engaging teeth 130 provide a plurality of complementary locking projections 134 and locking recesses 138 formed on the support portion 72 of the housing 14 and on the handle member 70. As shown in FIG. 3, the clamping force applied by the locking member 86 to the housing 14 causes close engagement of the inter-engaging teeth 130. As shown in FIG. 5, release of the clamping force allows the inter-engaging teeth 130 to be disengaged and moved relative to each other.

In the preferred embodiment, the locking assembly 82 provides both a frictional engagement, through the clamping force applied by locking member 86 to the support portion 72 of the housing 14, and a positive engagement, through the inter-engaging teeth 130. In other constructions (not shown), however, the locking assembly 82 may only provide either a frictional engagement or a positive engagement.

For example, the locking assembly 82 may include only the frictional engagement provided by a locking member, similar to the locking member 86, applying a clamping force to the support portion of the housing 14. Alternatively, the locking assembly 82 may provide only the positive engagement, such as by a locking projection that is engageable with a locking recess to fix the handle member 70 in a position relative to the housing 14. Such a positive engagement could be provided by a detent assembly between the handle member 70 and the support portion 72 of the housing 14 with locking recesses corresponding to respective positions of the handle member 70 relative to the housing 14.

The circular saw 10 also includes (see FIGS. 3-7) a switch assembly 142 for selectively connecting the motor 18 to the power source to energize the motor 18. The switch assembly 142 is operable between an unoperated condition, in which the motor 18 is not connected to the power source, and an operated condition, in which the motor 18 is connected to the power source. The switch assembly 142 includes a depressable trigger 146 connected to an on/off switch 150. In the illustrated construction, the trigger 146 and the switch 150 are mounted for movement with the handle member 70 and relative to the motor 18.

The circular saw 10 also includes means for connecting the switch 150 to the motor 18. The connecting means accommodates movement of the switch 150 relative to the motor 18 so that, in any position of the handle member 70 relative to the housing 14, the switch 150 is operable to selectively connect the motor 18 to the power source.

In the illustrated construction, the connecting means includes a wiring arrangement 154 (see FIGS. 3-5) to electrically connect the switch 150 to the motor 18. The wiring arrangement 154 includes wires 158 extending through a narrow opening 160 in the handle member 70 and connected to the motor 18 by respective connectors 162. The

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wiring arrangement 154 includes an amount of wire 158 sufficient to accommodate movement of the switch 150 to the extreme pivoted positions (shown in solid and phantom lines in Fig. 3) of the handle member 70 relative to the housing 14. The narrow opening 160 limits the movement of one end of the wires 158 thereby locating the wires 158 during movement of the handle member 70. The connectors 162 limit the movement of other end of wires 158.

In another construction (not shown), the connecting means may include a fixed first conductor mounted on the housing 14 and electrically connected to the motor 18. The first conductor extends along the path of movement of the handle member 70. In this construction, the connecting means also includes a movable second conductor fixed to the handle member 70 and electrically connected to the switch 150. The second conductor is movably connected to the first conductor and moves along the first conductor to thereby maintain the electrical connection between the switch 150 and the motor 18 at any position of the handle member 70 relative to the housing 14.

In yet another construction (not shown), the connecting means may include a remote transmitter and sensor combination to connect the switch 150 to the motor 18. In this construction, the transmitter is fixed to and moves with the handle member 70. The transmitter transmits a signal based on the condition of the switch 150, for example, an "ON" signal or an "OFF" signal. The sensor or receiver is mounted on the housing 14 and electrically connected to the motor 18. The sensor senses the transmitted signal and, if, for example, the "ON" signal is transmitted, connects the motor 18 to the power source. In this construction, the power source is directly connectable to the motor 18, rather than being connected through the switch 150.

A cover 166 is positioned over the motor 18 and the connecting means. In the illustrated construction, the cover 166 includes a channel 170 that accommodates movement of the wires 156 between the extreme pivoted positions (shown in solid and phantom lines in FIG. 3). The channel 170 also insures that the wiring arrangement 154 is protected and not damaged during movement of the handle member 70 relative to the housing 14.

The circular saw 10 also includes (see FIGS. 4-7) means for preventing the switch assembly 142 from connecting the motor 18 to the power source when the locking assembly 82 is in the unlocked condition. Further, the circular saw 10 includes means for preventing the locking assembly 82 from being operated from the locked condition to the unlocked condition when the switch assembly 142 is in the operated condition. The locking assembly 82 and the switch assembly 142 interact to prevent unintentional operation of one assembly when the other assembly is being operated.

The preventing means are provided by a locking plate 174 which interacts with both the locking assembly 82 and the switch assembly 142. The locking plate 174 includes an end 178 for engagement with the tab 122 of the actuating member 102. At the other end, the locking plate 174 includes a blocking portion 182 and an aperture 186. A depressable button 188 is connected to the locking plate 174. The button 188 includes an elongated portion to provide a debris barrier. A spring member 190 biases the locking plate 174 toward engagement with the actuating member 102 (in the direction of arrow B in FIGS. 4 and 5).

As shown in FIG. 5, with the locking assembly 82 in the unlocked condition, the locking plate 174 is moved by the spring member 190 in the direction of arrow B to a position in which the blocking portion 182 engages an upper portion 194 of the trigger 146. In this position, movement of the trigger 146 is prevented, thereby preventing the switch 150 from connecting the motor 18 to the power source.

During movement of the actuating member 102 to the locked position, the tab 122 engages the end 178 and moves

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the locking plate 174 in the direction opposite to arrow B. Alternatively, the operator depresses the button 188 to move the locking plate 174. Once the actuating member 102 is in the locked position, the end 178 engages in the recess formed on the tab 122.

As shown in FIG. 4, with the locking assembly 82 in the locked condition, the locking plate 174 is in a position in which the upper portion 194 of the trigger 146 is movable into the aperture 186. In this position, the locking plate 174 does not block movement of the trigger 146 and does not prevent the switch 150 from connecting the motor 18 to the power source.

In order to move the actuating member 102 to the unlocked position, the locking plate 174 must be moved in the direction opposite to arrow B. To move the locking plate 174, the operator depresses the button 188, disengaging the end 178 from recess formed on the tab 122. In the illustrated construction, the actuating member 102 cannot be moved to the unlocked position without the operator depressing the button 188. This reduces the likelihood that the actuating member 102 can be accidentally moved to the unlocked position and that the locking assembly 82 can be accidentally released.

In another construction (not shown), the locking plate 174 does not include the button 188. An unlocking force applied by the operator to move the actuating member 102 to the unlocked position causes the tab 122 to move the locking plate 174 in the direction opposite to arrow B. In such a construction, the configuration of the tab 122 would ensure that the required unlocking force is much greater than a force that would be applied if, for example, the operator accidentally pulled on the actuating member 102. This construction also reduces the likelihood of the locking assembly 82 being accidentally unlocked.

In either construction, however, when the trigger 146 is depressed (as shown in solid lines in FIG. 4), the upper portion 194 of the trigger 146 engages the forward wall of the aperture 186, and the locking plate 174 is prevented from moving in the direction opposite to arrow B. Thus, the locking plate 174 provides a means for preventing the locking assembly 82 from being moved from the locked condition to the unlocked condition when the switch assembly 142 is in the operated condition.

With the trigger in the unoperated condition (as shown in phantom lines in FIG. 4), the upper portion 194 of the trigger 146 does not engage the forward wall of the aperture 186. The locking plate 174 can be moved in the direction opposite to arrow B, and the actuating member 102 can be moved to the unlocked position (shown in FIG. 5).

In other constructions (not shown), the preventing means may be provided by other mechanical interaction between the locking assembly 82 and the switch assembly 142. For example, the preventing means may be provided by direct interaction (not shown) between the trigger 146 and the actuating member 102 without an additional component such as the locking plate 174.

In yet other constructions, the preventing means may be provided by nonmechanical means, such as by additional electrical switches which must be operated to enable operation of the locking assembly 82 and/or the switch assembly 142. For example, the locking assembly 82 can include a switch (not shown) electrically connected to the switch 150. This additional switch would prevent the switch 150 from connecting the motor 18 to the power source when the locking assembly 82 is in the unlocked condition.

In the illustrated construction, the switch assembly 142 also includes (see FIGS. 3-7, 8A and 8B) a shuttle switch 198 for further preventing unintentional operation of the trigger 146, thereby further preventing unintentional opera-

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tion of the switch 150 and the motor 18. The shuttle switch 198 is supported for lateral movement (in the direction of arrow C in FIGS. 8A and 8B) by the handle member 70. The shuttle switch 198 includes (see FIGS. 8A and 8B) two ribs 202 and defines three pockets 206. A biasing member 210 (see FIG. 6) biases the shuttle switch 198 to a centered position (as shown in FIG. 8A).

With the shuttle switch 198 in the centered position (shown in FIG. 8A), the upper portion 194 of the trigger 146 contacts the ribs 202, preventing the switch 150 from connecting the motor 18 to the power source. To operate the switch 150, the shuttle switch 198 must first be moved laterally (in the direction of arrow C in FIGS. 8A and 8B) against the force of the biasing member 210. With the shuttle switch 198 in a lateral position (such as that shown in FIG. 8B), the upper portion 194 of the trigger 146 does not contact the ribs 202 but passes into the pockets 206 defined between the ribs 202. The trigger 146 can thus operate the switch 150 to connect the motor 18 to the power source. It should be understood that the shuttle switch 198 can also be to a lateral position opposite to that shown in FIG. 8B to allow movement of the trigger 146.

Movement of the shuttle switch 198 to a lateral position (such as that shown in FIG. 8B) does not affect operation of the trigger 146 when the locking assembly 82 is in the unlocked condition (as shown in FIG. 5). Further, with the locking assembly 82 in the locked condition, the shuttle switch 198 must also be moved to the position shown in FIGS. 4 and 8B to allow the trigger 146 to be operated.

In operation, the operator selects the desired position of the handle member 70 relative to the housing 14 and ensures that the locking assembly 82 is in the locked condition as shown in FIGS. 1A, 2 and 4. The operator then operates the circular saw 10 to cut the workpiece W.

When the operator wants to change the position of the handle member 70 relative to the housing 14, for example, when the depth of cut of the saw blade 22 is adjusted, the operator first moves the switch assembly 142 to the unoperated condition by releasing the trigger 146.

The operator can then move the locking assembly 82 to the unlocked condition. The button 188 is depressed, and the actuating member 102 is moved to the unlocked position (as shown in FIG. 5) so that the locking member 86 does not apply a clamping force to the support portion 72 of the housing 14 and the inter-engaging teeth 130 are disengaged. The handle member 70 is then moved to the desired position relative to the housing 14, and the locking assembly 82 is moved to the locked condition. The locking member 86 applies the clamping force to the support portion 72 of the housing 14, and the inter-engaging teeth 130 are engaged. To continue cutting operations, the operator then moves the shuttle switch 198 to a lateral position (such as that shown in FIG. 8B), and depresses the trigger 146 to operate the motor 18 and cut the workpiece W.

As shown in Figs. 1A-1C, the operator can adjust the handle member 70 after the depth of cut of the saw blade 22 has been adjusted to maintain a "push handle" orientation (illustrated in FIGS. 1A and 1C). The operator can also adjust the position of the handle member 70 to provide additional comfort to the operator. For example, if the operator is cutting a workpiece W that is positioned lower than the operator's waist, the operator might prefer a top handle position and may thus move the handle member 70 upwardly. Alternatively, in some cutting operations, the operator may prefer the "push handle" orientation to the "top handle" orientation. The operator can then move the handle member 70 from the higher "top handle" orientation to the lower "push handle" orientation.

Various features of the invention are set forth in the following claims.

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We claim:

1. A method of operating a circular saw, the circular saw including a motor operable to rotatably drive a saw blade about an axis, a motor housing supporting the motor, and a handle supported by the housing, said method comprising the acts of:

positioning the handle in a first position relative to the housing;

operating the motor to drive the saw blade; and

moving the handle relative to the housing to a second position.

2. The method as set forth in claim 1 wherein said moving act includes pivoting the handle relative to the housing to the second position.

3. The method as set forth in claim 1 and further comprising the act of locking the handle in a position relative to the housing.

4. The method as set forth in claim 3 wherein said locking act includes locking the handle in the first position relative to the housing.

5. The method as set forth in claim 4 and further comprising, before said moving act, unlocking the handle so that the handle is movable relative to the housing from the first position.

6. The method as set forth in claim 5 wherein, during said operating act, said unlocking act is prevented.

7. The method as set forth in claim 4 wherein said locking act includes selectively locking the handle in the first position relative to the housing and in the second position relative to the housing.

8. The method as set forth in claim 1 wherein, during said operating act, said moving act is prevented.

9. The method as set forth in claim 1 wherein, during said moving act, said operating act is prevented.

10. A method of operating a circular saw, the circular saw including a motor operable to rotatably drive a saw blade about an axis, a motor housing supporting the motor, and a handle supported by the housing, said method comprising the acts of:

positioning the handle in a first position relative to the housing;

operating the motor to drive the saw blade; and

pivoting the handle relative to the housing to a second position.

11. The method as set forth in claim 10 wherein said pivoting act includes pivoting the handle about the axis.

12. The method as set forth in claim 10 wherein said pivoting act includes pivoting the handle about a second axis.

13. The method as set forth in claim 12 wherein the second axis is parallel to the first-mentioned axis.

14. The method as set forth in claim 13 wherein the second axis is co-axial with the first-mentioned axis.

15. The method as set forth in claim 10 and further comprising the act of locking the handle in a pivoted position relative to the housing.

16. The method as set forth in claim 15 and further comprising the act of unlocking the handle so that the handle is pivotable from the pivoted position.

17. The method as set forth in claim 16 wherein, during said operating act, said unlocking act is prevented.

18. The method as set forth in claim 10 wherein, during said operating act, said moving act is prevented.

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19. The method as set forth in claim 10 wherein, during said moving act, said operating act is prevented.

20. A method of operating a circular saw, the circular saw including a motor operable to rotatably drive a saw blade about an axis, a motor housing supporting the motor, and a handle supported by the housing, said method comprising the acts of:

positioning the handle in a first position relative to the housing;

locking the handle in the first position;

operating the motor to drive the saw blade;

unlocking the handle so that the handle is movable relative to the housing from the first position; and

moving the handle relative to the housing to a second position.

21. The method as set forth in claim 20 and further comprising, after said act of moving the handle to a second position, the act of locking the handle in the second position.

22. The method as set forth in claim 20 wherein said moving act includes pivoting the handle relative to the housing to the second position.

23. The method as set forth in claim 20 wherein the circular saw further includes a locking assembly operable to lock the handle in a position relative to the housing, and a switch assembly operable to selectively connect the motor to a power source, wherein said locking act includes operating the locking assembly to a locked condition, wherein said unlocking act includes operating the locking assembly to an unlocked condition, and wherein said operating act includes

operating the switch assembly to an operated condition such that the motor is connected to the power source, and

when the switch assembly is in the operated condition, preventing the locking assembly from being operated to the unlocked condition.

24. The method as set forth in claim 23 wherein, during said moving act, said act of operating the switch assembly to an operated condition is prevented.

25. The method as set forth in claim 20 wherein the circular saw further includes a switch assembly operable to selectively connect the motor to a power source, wherein said operating act includes operating the switch assembly to an operated condition such that the motor is connected to the power source, and wherein said moving act includes preventing the switch assembly from being operated to the operated condition.

26. The method as set forth in claim 20 wherein said locking act includes applying a clamping force to one of the housing and the handle to lock the handle in the first position relative to the housing.

27. The method as set forth in claim 26 wherein said locking act includes applying the clamping force to the housing to lock the handle in the first position relative to the housing.

28. The method as set forth in claim 20 wherein, during said operating act, said unlocking act is prevented.

29. The method as set forth in claim 20 wherein, during said operating act, said moving act is prevented.

30. The method as set forth in claim 20 wherein, during said moving act, said operating act is prevented.

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(12) **United States Patent**
Zeiler et al.

(10) **Patent No.:** **US 6,588,112 B2**
(45) **Date of Patent:** ***Jul. 8, 2003**

(54) **MOVABLE HANDLE FOR A POWER TOOL**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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This patent is subject to a terminal disclaimer.

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(57) **ABSTRACT**

A movable handle for a power tool. The power tool comprises a housing, a motor supported by the housing and operable to drive a tool element about an axis, and a handle supported by the housing for rotation relative to the housing about the axis. Preferably, the power tool is a circular saw. The circular saw further comprises a switch assembly supported on the handle for movement with the handle and means for connecting the switch to the motor to accommodate movement of the switch relative to the motor. The switch assembly is electrically connectable to the motor and selectively connects the motor to a power source, and the connecting means includes a wiring arrangement. The circular saw further comprises a locking assembly for locking the handle in a position relative to the housing. Also, the circular saw preferably comprises means for preventing the switch assembly from connecting the motor to the power source when the locking assembly is in the unlocked condition and means for preventing the locking assembly from being operated from the locked condition to the unlocked condition when the switch assembly is in the operated condition.

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(51) **Int. Cl.**⁷ **B23D 45/16**

(52) **U.S. Cl.** **30/391; 30/390**

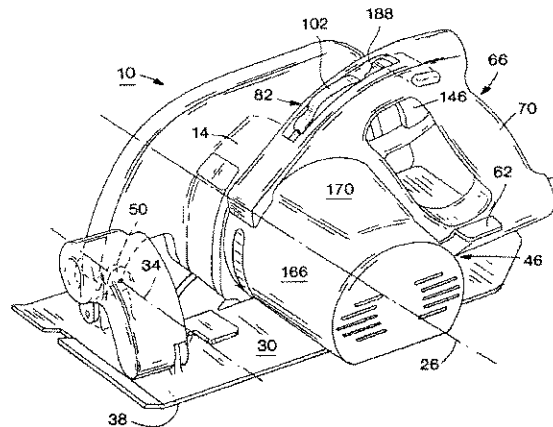
(58) **Field of Search** 30/388-391, 382, 30/122

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40 Claims, 7 Drawing Sheets

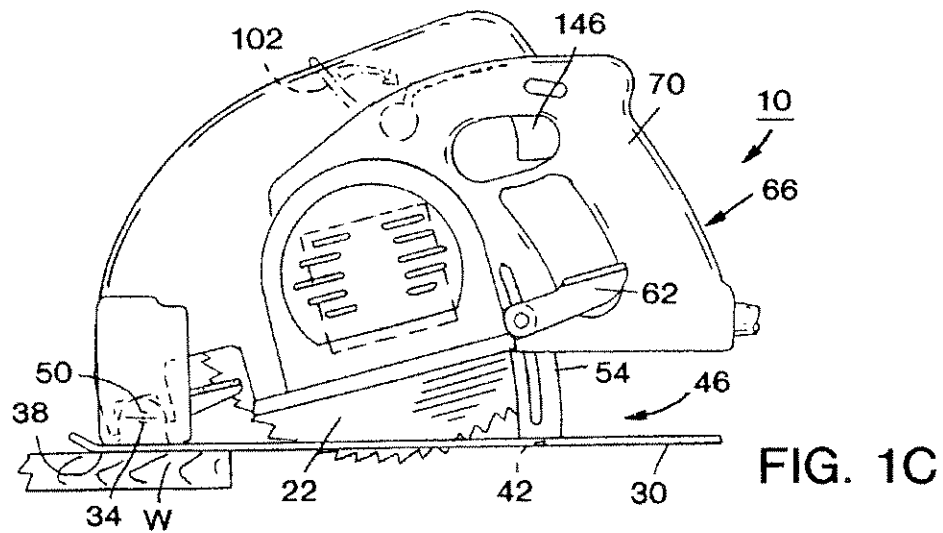
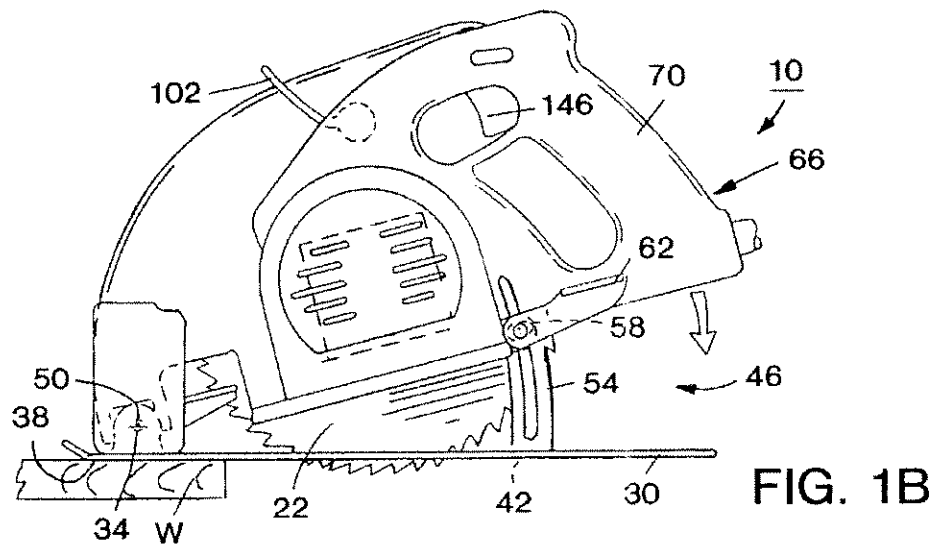
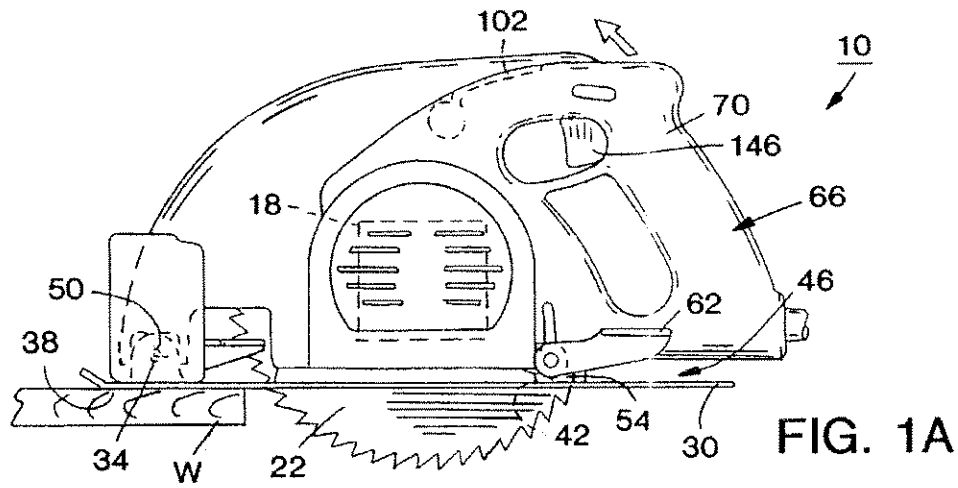


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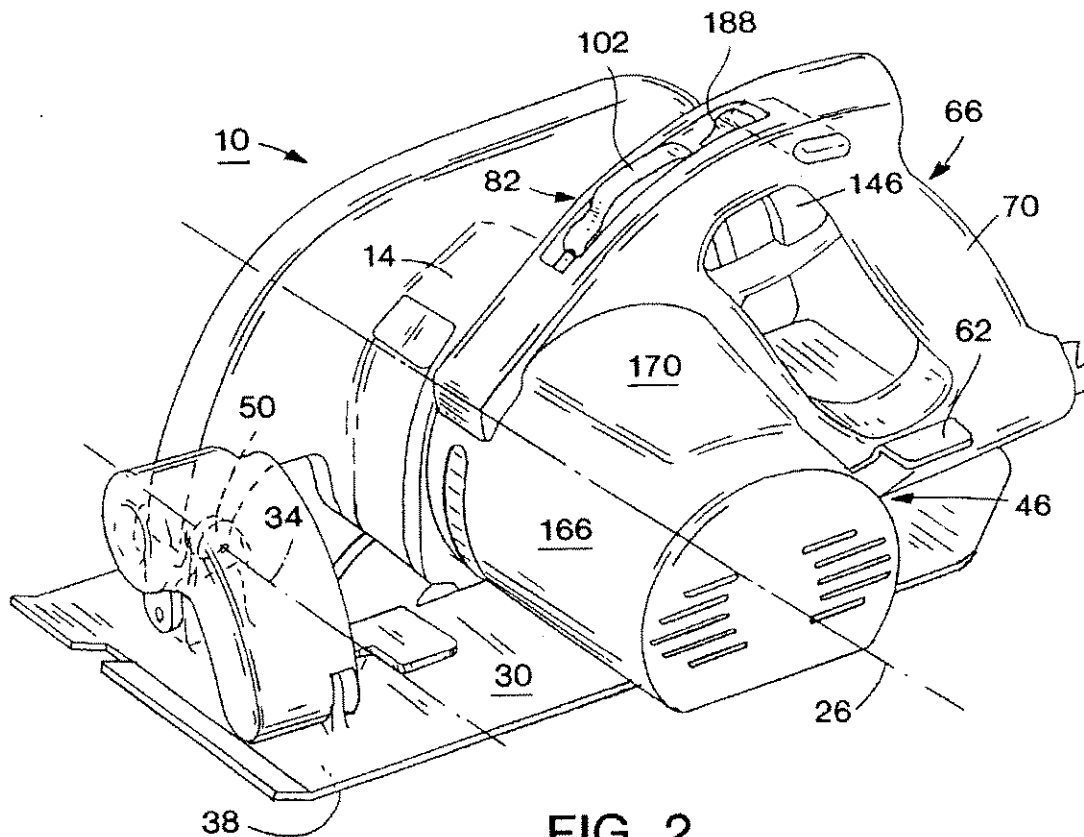


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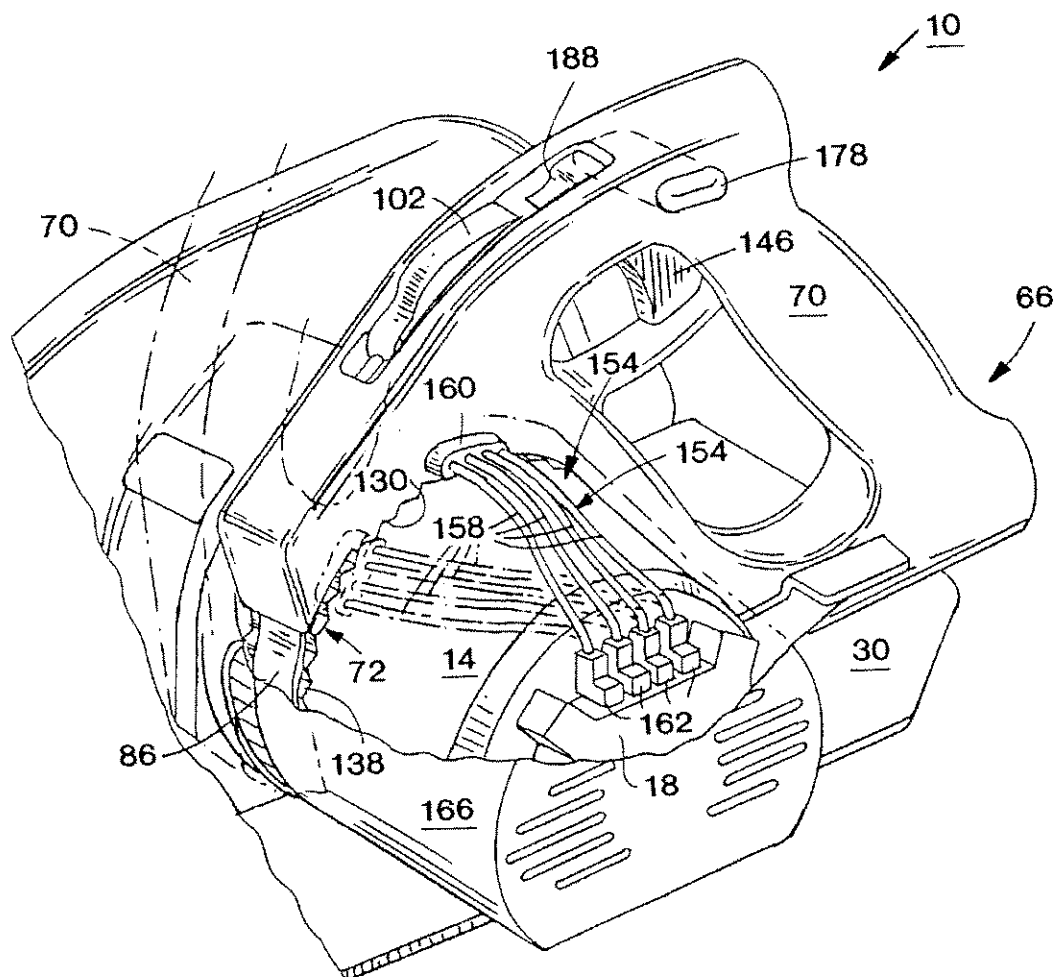


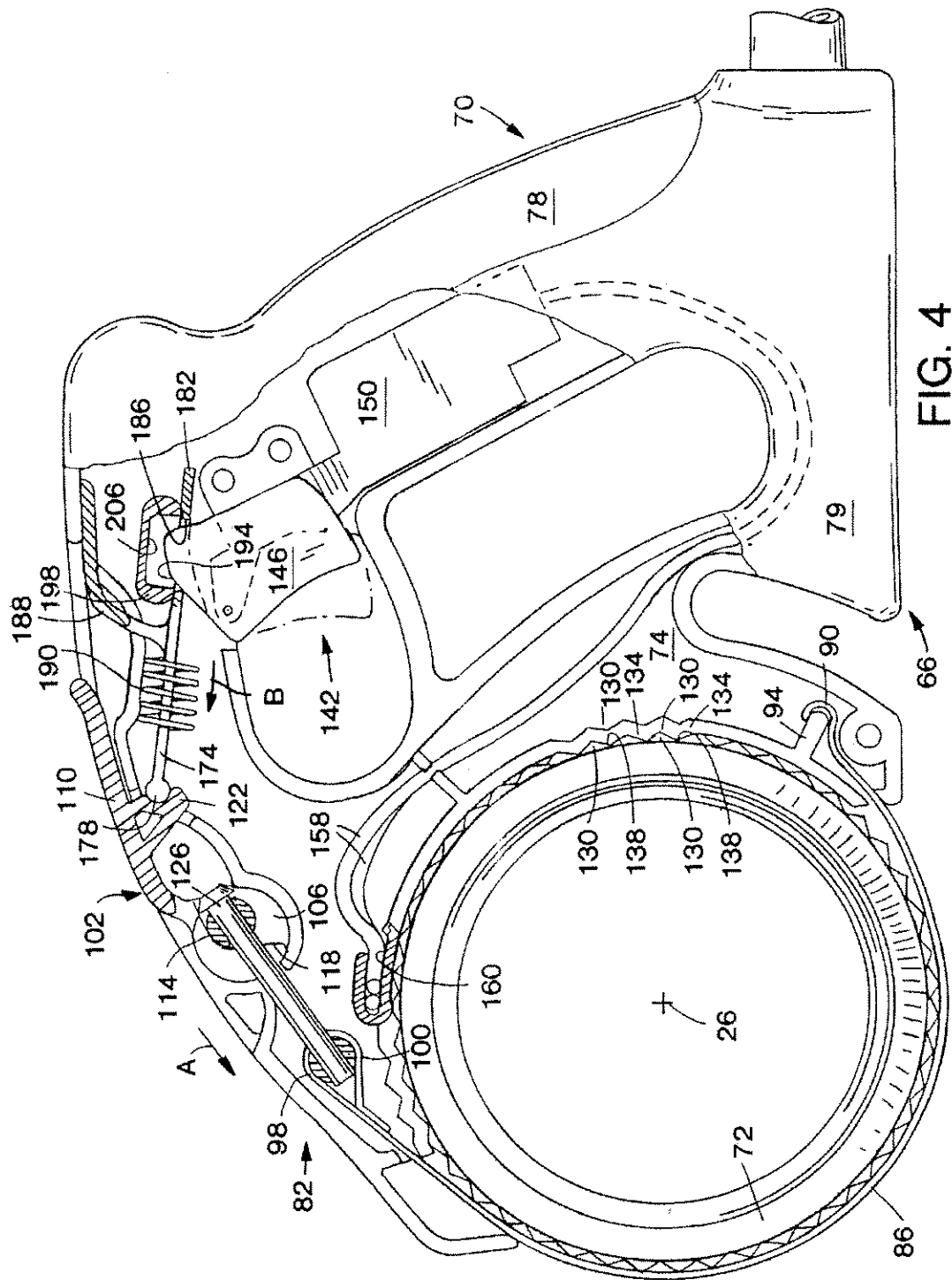
FIG. 3

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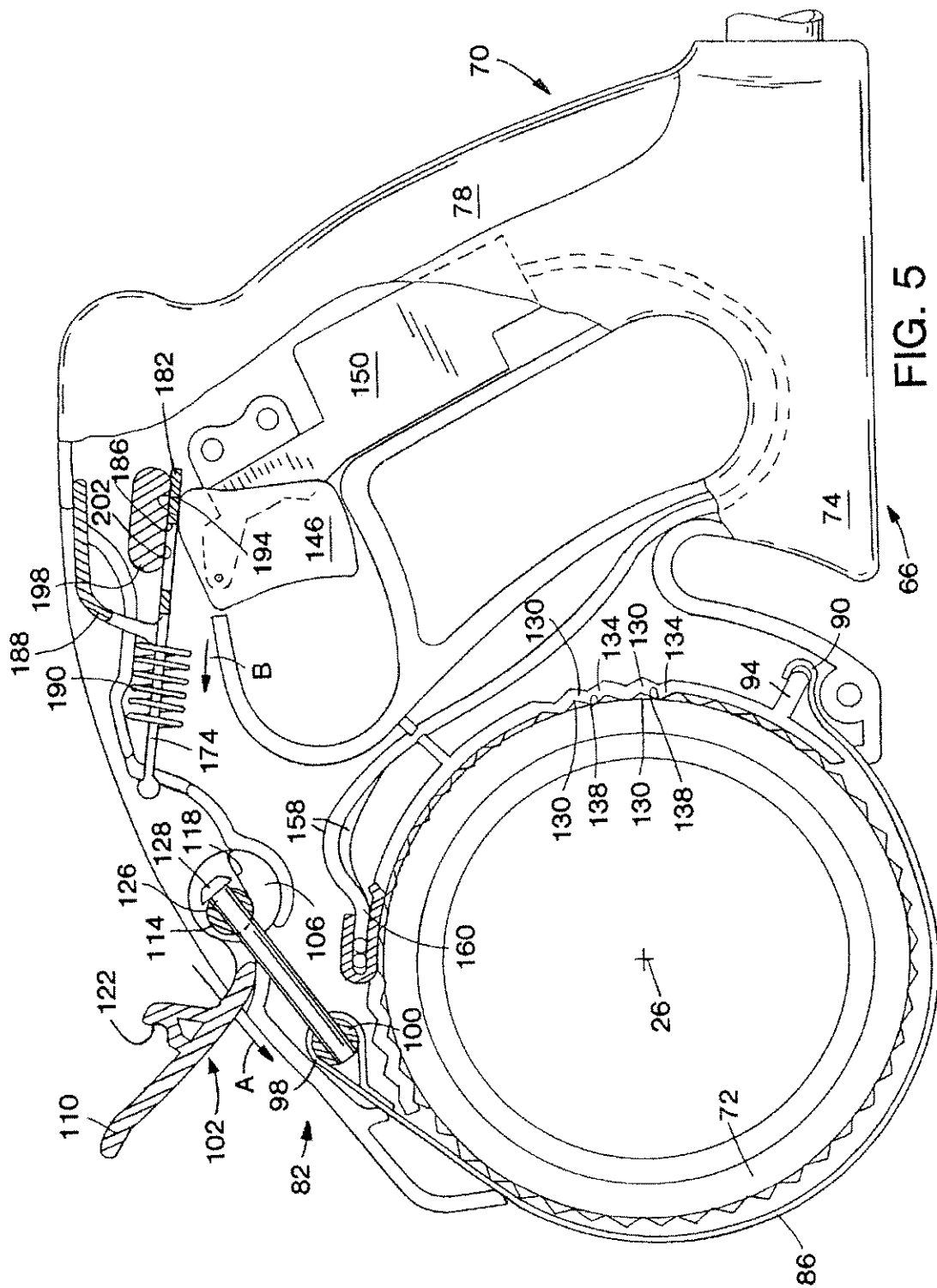


FIG. 5

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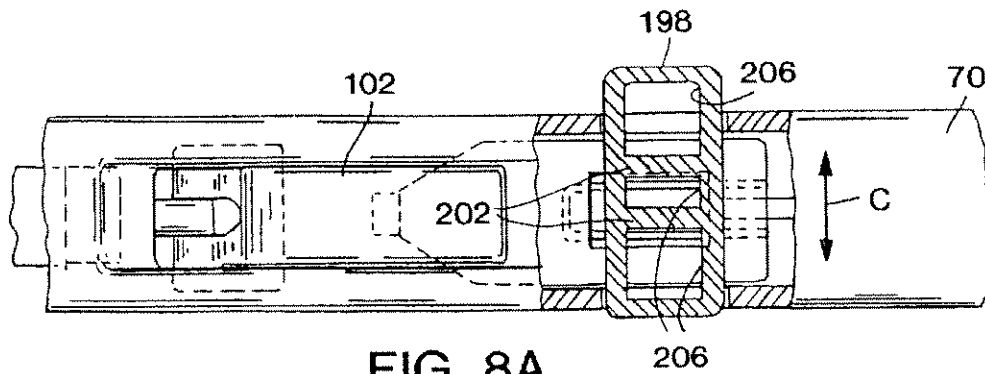


FIG. 8A

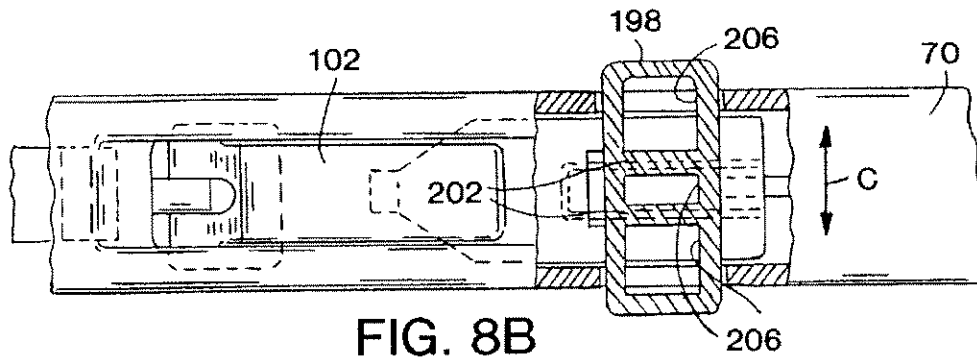


FIG. 8B

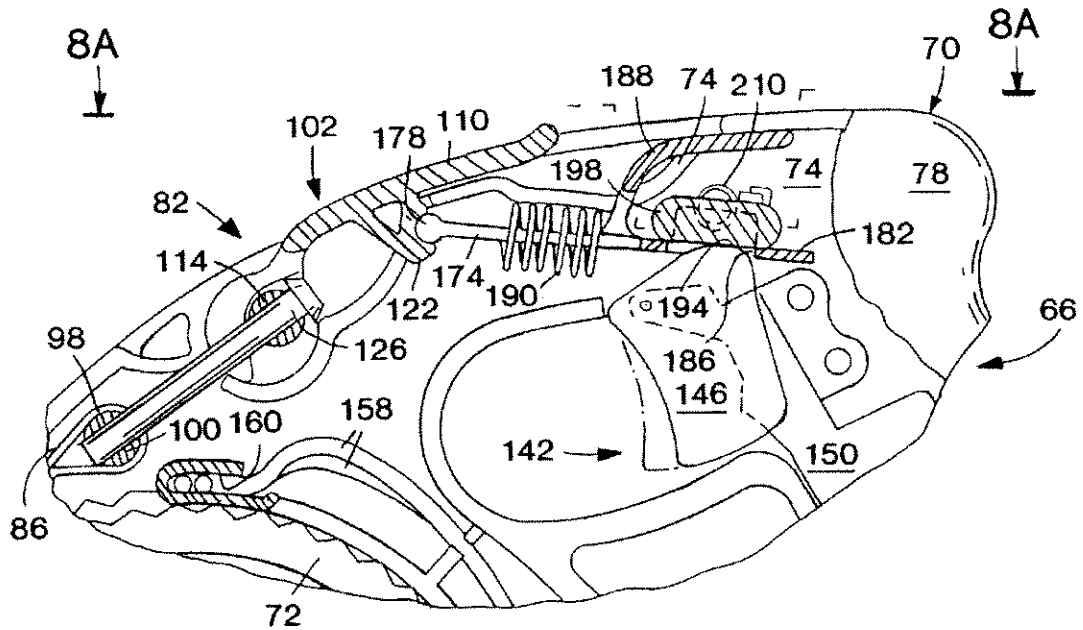
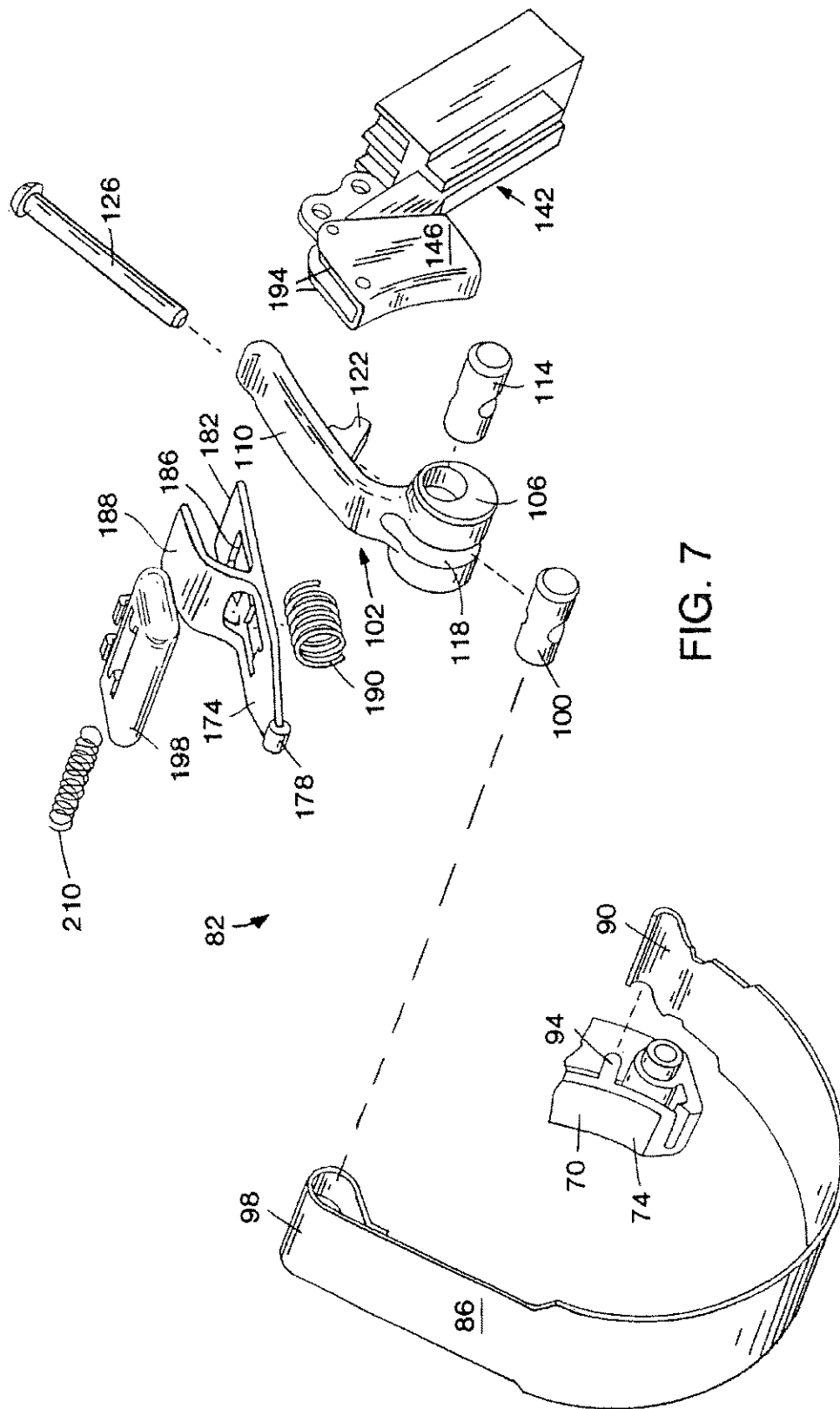


FIG. 6



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MOVABLE HANDLE FOR A POWER TOOL**RELATED APPLICATION**

This is a division of patent application Ser. No. 09/618, 217, filed Jul. 18, 2000 now U.S. Pat. No. 6,301,790, which is a continuation of patent application Ser. No. 09/134,626, filed Aug. 14, 1998, now U.S. Pat. No. 6,108,916, issued Aug. 29, 2000.

BACKGROUND OF THE INVENTION

The present invention relates to power tools and, more particularly, to a handle arrangement for power tools.

A power tool, such as a circular saw, generally includes a housing supporting a motor which rotatably drives a tool element, such as a saw blade. Typically, an operator's handle is integrally formed with the housing. In a circular saw, a shoe plate supports the saw on the surface of a workpiece.

In some circular saws, the housing is adjustable relative to the shoe plate to change the depth of cut of the saw blade. For example, the housing may pivot relative to the shoe plate about an axis adjacent the front of the shoe plate (front pivot depth adjustment) or about an axis adjacent the rear of the shoe plate (rear pivot depth adjustment). In another construction, the shoe plate is slidably lowered and raised relative to the housing (drop shoe depth adjustment). In each of these depth adjustment arrangements, when the depth of cut of the saw blade is adjusted, the position and/or orientation of the handle relative to the workpiece is also adjusted.

U.S. Pat. No. 4,516,324 discloses a modular housing system for a circular saw. The circular saw includes a single, one-piece housing having an interface portion which interchangeably mounts either a pivot adjust subassembly or a vertical (drop shoe) adjust subassembly for changing the depth of cut of the circular saw. The main handle can have either a "push handle" configuration or a "top handle" configuration. The selected handle component is slipped onto the one-piece field case and secured by fasteners.

SUMMARY OF THE INVENTION

One of the problems with a circular saw including an operator's handle that is integrally formed with the housing, is that, in some cutting operations, the operator may prefer a "push handle" to a "top handle" or vice versa. However, the operator cannot adjust the handle to the desired position relative to the housing. Another problem with a circular saw with an integral handle is that, when the depth of cut of the saw blade is adjusted, the handle position and orientation also changes. The resulting handle position is often uncomfortable and is seldom the optimal position for operation of the circular saw.

For example, in a circular saw with a front pivot depth adjustment assembly, at full depth of cut, the handle is typically positioned as a "push handle". At a minimum depth of cut, the handle position is changed to a "top handle" position. In a circular saw with a rear pivot depth adjustment assembly, at full depth of cut, the handle must be oriented above a typical "push handle" position because, when the saw is adjusted to a minimum depth of cut, the handle is lowered.

One problem with the handle arrangement disclosed in U.S. Pat. No. 4,516,324 is that the circular saw includes two separate handles. The handle component that is not in use must be stored and may be lost or damaged.

Another problem with the handle arrangement disclosed in U.S. Pat. No. 4,516,324 is that the saw includes a handle

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that is only a "push handle" or a "top handle" and that is not adjustable between these configurations. Additional fasteners are also required.

The present invention provides a handle arrangement for a power tool that alleviates the problems with the above-described handle arrangements. The invention provides a power tool, such as a circular saw, that includes a handle that is movable relative to the motor housing. Preferably, the handle is pivotable about the axis of the saw blade relative to the motor housing.

Also, the invention provides a locking assembly for locking the handle in a position relative to the housing. Preferably, the locking assembly provides a frictional engagement between the handle and the housing and includes a clamping member that releasably applies a clamping force to the housing to lock the handle in a position relative to the housing. Preferably, the locking assembly also provides a positive engagement between the handle and the housing and includes inter-engaging teeth formed on both the handle and the housing.

Further, the invention provides means for connecting the switch to the motor to accommodate movement of the switch with the handle and relative to the motor. Preferably, the connecting means are provided by a wiring arrangement.

In addition, the invention provides interaction between the switch and the locking assembly to prevent inadvertent operation of one when the other is operated. Specifically, the switch preferably cannot be operated when the locking assembly is unlocked, and the locking assembly cannot be unlocked when the switch is connecting the motor to the power source.

One advantage of the present invention is that the handle is movable relative to the housing of the power tool to allow the operator to position the handle as desired for a given cutting operation. As a result, the operator can adjust the handle to a position that is most comfortable and allows the greatest control of the circular saw during cutting operations.

Another advantage of the present invention is that, when the circular saw is adjusted to change the depth of cut of the saw blade, the operator can also adjust the handle to an optimum position for the given cutting operation.

Yet another advantage of the present invention is that the circular saw does not include additional components that must be substituted for one another to change the configuration of the handle or additional fasteners. This reduces the chance that such an additional component is lost or damaged and also eliminates the need to store additional components.

A further advantage of the present invention is that the handle is adjustable to substantially any position between a first position, such as a "push handle" position, and a second position, such as a "top handle" position.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings.

DESCRIPTION OF THE DRAWINGS

FIGS. 1A, 1B and 1C are side views of a power tool embodying the invention and illustrating the adjustment of the handle arrangement.

FIG. 2 is a perspective view of the power tool shown in FIGS. 1A-1C.

FIG. 3 is an enlarged perspective view of a portion of the power tool shown in FIG. 2 with portions cut away.

FIG. 4 is a side partial cross-sectional view of the handle arrangement shown in FIG. 3.

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FIG. 5 is a view similar to that shown in FIG. 4 and illustrating the locking assembly in an unlocked condition.

FIG. 6 is an enlarged partial cross-sectional view of a portion of the handle arrangement shown in FIG. 4.

FIG. 7 is an exploded perspective view of a portion of the handle arrangement shown in FIG. 4.

FIG. 8A is a view taken generally along line 8A—8A in FIG. 6.

FIG. 8B is a view similar to that shown in FIG. 8A and illustrating the shuttle switch in a lateral position.

Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of the construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A power tool embodying the invention is illustrated in FIG. 1A. In the illustrated construction, the power tool is a circular saw 10 and includes a motor housing 14 supporting an electric motor 18 (shown schematically in FIG. 1A). The motor 18 is connectable to a power source and is operable to rotatably drive a tool element, such as a saw blade 22, about an axis 26 to cut a workpiece W.

The circular saw 10 also includes (see FIGS. 1A–1C) a shoe plate 30 connected to the housing 14 for pivotal movement about a pivot axis 34. The shoe plate 30 has a support surface 38 for supporting the circular saw 10 on the surface of the workpiece W. An aperture 42 is defined by the shoe plate 30. A portion of the saw blade 22 extends through the aperture 42 to cut the workpiece W. FIG. 1A illustrates the shoe plate 30 adjusted so that the saw blade 22 is at a maximum depth of cut. FIGS. 1B and 1C illustrate the shoe plate 30 adjusted so that the saw blade 22 is at a minimum depth of cut.

In the illustrated construction, the circular saw 10 includes a front pivot depth adjustment assembly 46 to adjust the depth of cut of the saw blade 22. The depth adjustment assembly 46 includes a pivot member 50 defining the pivot axis 34 and pivotally connecting the shoe plate 30 to the housing 14. As shown in FIG. 1B, a guide member 54 cooperates with a depth adjustment locking member 58 (shown in phantom) to lock the shoe plate 30 in a pivoted position relative to the housing 14 thereby fixing the depth of cut of the saw blade 22. A depth adjustment lever 62 operates the locking member 58 between locked and unlocked positions.

In other constructions (not shown), the circular saw 10 may include, for example, a rear pivot depth adjustment assembly or a drop shoe depth adjustment assembly rather than the front pivot depth adjustment assembly 46. It should be understood that the present invention applies to a circular saw with any type of depth adjustment assembly.

The circular saw 10 also includes (see FIGS. 2–6) a movable handle arrangement 66. The movable handle arrangement 66 includes a main operator's handle member 70 movably supported on a support portion 72 of the housing 14 so that the position of the handle member 70 is adjustable relative to the housing 14. Further, with the depth adjustment assembly 46 locked and the saw blade 22 at a desired depth

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of cut, the handle member 70 is adjustable relative to the shoe plate 30 and relative to the surface of the workpiece W (as shown in the change of position between FIGS. 1B and 1C).

In the illustrated construction, the handle member 70 has (see FIGS. 4–6) opposite handle halves 74 and a rearward grip member 78. Further, in the illustrated construction, the handle member 70 is supported to be pivotable about the axis 26 of the saw blade 22 relative to the housing 14. However, in other constructions (not shown), the handle member 70 may be pivotable about an axis that is generally parallel to the axis 26. Also, in yet other constructions (not shown), the handle member 70 may be slidable along an axis normal to the axis 26 relative to the housing 14. The circular saw 10 also includes (see FIGS. 3–7) a locking assembly 82 to fix the handle member 70 on the support portion 72 of the housing 14 in a pivoted position relative to the housing 14. As explained in more detail below, the locking assembly 82 is operable between a locked condition (shown in FIGS. 4 and 6), in which the handle member 70 is fixed in a position relative to the housing 14, and an unlocked condition (shown in FIG. 5), in which the position of the handle member 70 relative to the housing 14 is adjustable.

The locking assembly 82 includes (see FIGS. 3–7) a locking member 86 which, in the illustrated construction, is a clamping band movably supported on the handle member 70 to releasably apply a clamping force to the support portion 72 of the housing 14. As shown in FIGS. 4 and 5, one end 90 of the locking member 86 is fixed to a stud 94 formed on the handle member 70. The other end 98 of the locking member 86 supports a through pin 100 and is movably connected to the handle member 70, as explained in more detail below. The handle member 70 and the locking member 86 are connected about the support portion 72 of the housing 14.

The locking assembly 82 also includes (see FIGS. 3–7) an actuating member 102 for moving the locking member 86 between a locked position and an unlocked position corresponding to the locked condition and the unlocked condition, respectively, of the locking assembly 82. The actuating member 102 is pivotably supported on the handle member 70 and includes a cam-shaped portion 106 and a lever portion 110. A tapped pin 114 is supported off-center in the cam-shaped portion 106, and an annular opening 118 is formed in the cam-shaped portion 106. A tab 122 extends from the lower surface of the lever portion 110.

To movably connect the end 98 of the locking member 86 to the handle member 70, the locking assembly 82 also includes a threaded pin 126 which engages the through pin 100 connected to the end 98 of the locking member 86. The threaded pin 126 also extends through the tapped pin 114 supported in the cam-shaped portion 106 of the actuating member 102. The annular opening 118 accommodates pivoting movement of the actuating member 102 relative to the threaded pin 126.

To move the locking member 86 between the locked and unlocked positions, the actuating member 102 is pivoted, moving the threaded pin 126 and the end 98 of the locking member 86. As the actuating member 102 is moved from the locked position (shown in FIG. 4) to the unlocked position (shown in FIG. 5), the threaded pin 126 is moved in the direction of arrow A. The locking member 86 is thus moved to the unlocked position (as shown in FIG. 5) and does not apply a clamping force to the support portion 72 to fix the handle member 70 in position relative to the housing 14.

To move the locking member 86 to the locked position, the actuating member 102 is moved from the unlocked

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position (shown in FIG. 5) to the locked position (shown in FIG. 4) causing the threaded pin 126 to be in the direction opposite to arrow A. The locking member 86 is thus moved to the locked position (shown in FIG. 4) and applies a clamping force to the support portion 72 of the housing 14.

In the unlocked position (shown in FIG. 5), the threaded pin 126 is adjustable to change the clamping force applied by the locking member 86 when the locking member 86 is in the locked position. With the actuating member 102 in the unlocked position, the exposed end 128 of the threaded pin 126 is accessible by the operator to threadably loosen or tighten the locking member 86. This adjustment of the locking member 86 may be necessary due to manufacturing tolerances or may become necessary due to wear of the movable handle arrangement 66.

The locking assembly 82 also includes (see FIGS. 3-5) inter-engaging teeth 130 formed on the support portion 72 of the housing 14 and on the handle member 70. The inter-engaging teeth 130 provide a plurality of complementary locking projections 134 and locking recesses 138 formed on the support portion 72 of the housing 14 and on the handle member 70. As shown in FIG. 3, the clamping force applied by the locking member 86 to the housing 14 causes close engagement of the inter-engaging teeth 130. As shown in FIG. 5, release of the clamping force allows the inter-engaging teeth 130 to be disengaged and moved relative to each other.

In the preferred embodiment, the locking assembly 82 provides both a frictional engagement, through the clamping force applied by locking member 86 to the support portion 72 of the housing 14, and a positive engagement, through the inter-engaging teeth 130. In other constructions (not shown), however, the locking assembly 82 may only provide either a frictional engagement or a positive engagement.

For example, the locking assembly 82 may include only the frictional engagement provided by a locking member, similar to the locking member 86, applying a clamping force to the support portion of the housing 14. Alternatively, the locking assembly 82 may provide only the positive engagement, such as by a locking projection that is engageable with a locking recess to fix the handle member 70 in a position relative to the housing 14. Such a positive engagement could be provided by a detent assembly between the handle member 70 and the support portion 72 of the housing 14 with locking recesses corresponding to respective positions of the handle member 70 relative to the housing 14.

The circular saw 10 also includes (see FIGS. 3-7) a switch assembly 142 for selectively connecting the motor 18 to the power source to energize the motor 18. The switch assembly 142 is operable between an unoperated condition, in which the motor 18 is not connected to the power source, and an operated condition, in which the motor 18 is connected to the power source. The switch assembly 142 includes a depressable trigger 146 connected to an on/off switch 150. In the illustrated construction, the trigger 146 and the switch 150 are mounted for movement with the handle member 70 and relative to the motor 18.

The circular saw 10 also includes means for connecting the switch 150 to the motor 18. The connecting means accommodates movement of the switch 150 relative to the motor 18 so that, in any position of the handle member 70 relative to the housing 14, the switch 150 is operable to selectively connect the motor 18 to the power source.

In the illustrated construction, the connecting means includes a wiring arrangement 154 (see FIGS. 3-5) to electrically connect the switch 150 to the motor 18. The

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wiring arrangement 154 includes wires 158 extending through a narrow opening 160 in the handle member 70 and connected to the motor 18 by respective connectors 162. The wiring arrangement 154 includes an amount of wire 158 sufficient to accommodate movement of the switch 150 to the extreme pivoted positions (shown in solid and phantom lines in FIG. 3) of the handle member 70 relative to the housing 14. The narrow opening 160 limits the movement of one end of the wires 158 thereby locating the wires 158 during movement of the handle member 70. The connectors 162 limit the movement of other end of wires 158.

In another construction (not shown), the connecting means may include a fixed first conductor mounted on the housing 14 and electrically connected to the motor 18. The first conductor extends along the path of movement of the handle member 70. In this construction, the connecting means also includes a movable second conductor fixed to the handle member 70 and electrically connected to the switch 150. The second conductor is movably connected to the first conductor and moves along the first conductor to thereby maintain the electrical connection between the switch 150 and the motor 18 at any position of the handle member 70 relative to the housing 14.

In yet another construction (not shown), the connecting means may include a remote transmitter and sensor combination to connect the switch 150 to the motor 18. In this construction, the transmitter is fixed to and moves with the handle member 70. The transmitter transmits a signal based on the condition of the switch 150, for example, an "ON" signal or an "OFF" signal. The sensor or receiver is mounted on the housing 14 and electrically connected to the motor 18. The sensor senses the transmitted signal and, if, for example, the "ON" signal is transmitted, connects the motor 18 to the power source. In this construction, the power source is directly connectable to the motor 18, rather than being connected through the switch 150.

A cover 166 is positioned over the motor 18 and the connecting means. In the illustrated construction, the cover 166 includes a channel 170 that accommodates movement of the wires 156 between the extreme pivoted positions (shown in solid and phantom lines in FIG. 3). The channel 170 also insures that the wiring arrangement 154 is protected and not damaged during movement of the handle member 70 relative to the housing 14.

The circular saw 10 also includes (see FIGS. 4-7) means for preventing the switch assembly 142 from connecting the motor 18 to the power source when the locking assembly 82 is in the unlocked condition. Further, the circular saw 10 includes means for preventing the locking assembly 82 from being operated from the locked condition to the unlocked condition when the switch assembly 142 is in the operated condition. The locking assembly 82 and the switch assembly 142 interact to prevent unintentional operation of one assembly when the other assembly is being operated.

The preventing means are provided by a locking plate 174 which interacts with both the locking assembly 82 and the switch assembly 142. The locking plate 174 includes an end 178 for engagement with the tab 122 of the actuating member 102. At the other end, the locking plate 174 includes a blocking portion 182 and an aperture 186. A depressable button 188 is connected to the locking plate 174. The button 188 includes an elongated portion to provide a debris barrier. A spring member 190 biases the locking plate 174 toward engagement with the actuating member 102 (in the direction of arrow B in FIGS. 4 and 5).

As shown in FIG. 5, with the locking assembly 82 in the unlocked condition, the locking plate 174 is moved by the

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spring member 190 in the direction of arrow B to a position in which the blocking portion 182 engages an upper portion 194 of the trigger 146. In this position, movement of the trigger 146 is prevented, thereby preventing the switch 150 from connecting the motor 18 to the power source.

During movement of the actuating member 102 to the locked position, the tab 122 engages the end 178 and moves the locking plate 174 in the direction opposite to arrow B. Alternatively, the operator depresses the button 188 to move the locking plate 174. Once the actuating member 102 is in the locked position, the end 178 engages in the recess formed on the tab 122.

As shown in FIG. 4, with the locking assembly 82 in the locked condition, the locking plate 174 is in a position in which the upper portion 194 of the trigger 146 is movable into the aperture 186. In this position, the locking plate 174 does not block movement of the trigger 146 and does not prevent the switch 150 from connecting the motor 18 to the power source.

In order to move the actuating member 102 to the unlocked position, the locking plate 174 must be moved in the direction opposite to arrow B. To move the locking plate 174, the operator depresses the button 188, disengaging the end 178 from recess formed on the tab 122. In the illustrated construction, the actuating member 102 cannot be moved to the unlocked position without the operator depressing the button 188. This reduces the likelihood that the actuating member 102 can be accidentally moved to the unlocked position and that the locking assembly 82 can be accidentally released.

In another construction (not shown), the locking plate 174 does not include the button 188. An unlocking force applied by the operator to move the actuating member 102 to the unlocked position causes the tab 122 to move the locking plate 174 in the direction opposite to arrow B. In such a construction, the configuration of the tab 122 would ensure that the required unlocking force is much greater than a force that would be applied if, for example, the operator accidentally pulled on the actuating member 102. This construction also reduces the likelihood of the locking assembly 82 being accidentally unlocked.

In either construction, however, when the trigger 146 is depressed (as shown in solid lines in FIG. 4), the upper portion 194 of the trigger 146 engages the forward wall of the aperture 186, and the locking plate 174 is prevented from moving in the direction opposite to arrow B. Thus, the locking plate 174 provides a means for preventing the locking assembly 82 from being moved from the locked condition to the unlocked condition when the switch assembly 142 is in the operated condition.

With the trigger in the unoperated condition (as shown in phantom lines in FIG. 4), the upper portion 194 of the trigger 146 does not engage the forward wall of the aperture 186. The locking plate 174 can be moved in the direction opposite to arrow B, and the actuating member 102 can be moved to the unlocked position (shown in FIG. 5).

In other constructions (not shown), the preventing means may be provided by other mechanical interaction between the locking assembly 82 and the switch assembly 142. For example, the preventing means may be provided by direct interaction (not shown) between the trigger 146 and the actuating member 102 without an additional component such as the locking plate 174.

In yet other constructions, the preventing means may be provided by non-mechanical means, such as by additional electrical switches which must be operated to enable opera-

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tion of the locking assembly 82 and/or the switch assembly 142. For example, the locking assembly 82 can include a switch (not shown) electrically connected to the switch 150. This additional switch would prevent the switch 150 from connecting the motor 18 to the power source when the locking assembly 82 is in the unlocked condition.

In the illustrated construction, the switch assembly 142 also includes (see FIGS. 3-7, 8A and 8B) a shuttle switch 198 for further preventing unintentional operation of the trigger 146, thereby further preventing unintentional operation of the switch 150 and the motor 18. The shuttle switch 198 is supported for lateral movement (in the direction of arrow C in FIGS. 8A and 8B) by the handle member 70. The shuttle switch 198 includes (see FIGS. 8A and 8B) two ribs 202 and defines three pockets 206. A biasing member 210 (see FIG. 6) biases the shuttle switch 198 to a centered position (as shown in FIG. 8A).

With the shuttle switch 198 in the centered position (shown in FIG. 8A), the upper portion 194 of the trigger 146 contacts the ribs 202, preventing the switch 150 from connecting the motor 18 to the power source. To operate the switch 150, the shuttle switch 198 must first be moved laterally (in the direction of arrow C in FIGS. 8A and 8B) against the force of the biasing member 210. With the shuttle switch 198 in a lateral position (such as that shown in FIG. 8B), the upper portion 194 of the trigger 146 does not contact the ribs 202 but passes into the pockets 206 defined between the ribs 202. The trigger 146 can thus operate the switch 150 to connect the motor 18 to the power source. It should be understood that the shuttle switch 198 can also be to a lateral position opposite to that shown in FIG. 8B to allow movement of the trigger 146.

Movement of the shuttle switch 198 to a lateral position (such as that shown in FIG. 8B) does not affect operation of the trigger 146 when the locking assembly 82 is in the unlocked condition (as shown in FIG. 5). Further, with the locking assembly 82 in the locked condition, the shuttle switch 198 must also be moved to the position shown in FIGS. 4 and 8B to allow the trigger 146 to be operated.

In operation, the operator selects the desired position of the handle member 70 relative to the housing 14 and ensures that the locking assembly 82 is in the locked condition as shown in FIGS. 1A, 2 and 4. The operator then operates the circular saw 10 to cut the workpiece W.

When the operator wants to change the position of the handle member 70 relative to the housing 14, for example, when the depth of cut of the saw blade 22 is adjusted, the operator first moves the switch assembly 142 to the unoperated condition by releasing the trigger 146.

The operator can then move the locking assembly 82 to the unlocked condition. The button 188 is depressed, and the actuating member 102 is moved to the unlocked position (as shown in FIG. 5) so that the locking member 86 does not apply a clamping force to the support portion 72 of the housing 14 and the inter-engaging teeth 130 are disengaged. The handle member 70 is then moved to the desired position relative to the housing 14, and the locking assembly 82 is moved to the locked condition. The locking member 86 applies the clamping force to the support portion 72 of the housing 14, and the inter-engaging teeth 130 are engaged. To continue cutting operations, the operator then moves the shuttle switch 198 to a lateral position (such as that shown in FIG. 5B), and depresses the trigger 146 to operate the motor 18 and cut the workpiece W.

As shown in FIGS. 1A-1C, the operator can adjust the handle member 70 after the depth of cut of the saw blade 22

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has been adjusted to maintain a "push handle" orientation (illustrated in FIGS. 1A and 1C). The operator can also adjust the position of the handle member 70 to provide additional comfort to the operator. For example, if the operator is cutting a workpiece W that is positioned lower than the operator's waist, the operator might prefer a top handle position and may thus move the handle member 70 upwardly. Alternatively, in some cutting operations, the operator may prefer the "push handle" orientation to the "top handle" orientation. The operator can then move the handle member 70 from the higher "top handle" orientation to the lower "push handle" orientation.

Various features of the invention are set forth in the following claims.

We claim:

1. A power tool comprising:
 - a housing;
 - a motor supported by said housing and operable to drive a tool element relative to a first axis;
 - a handle supported by said housing for movement relative to said housing about a second axis generally parallel to said first axis, said first axis and said second axis are fixed relative to said housing, said handle being shaped to be grasped by an operator to provide for movement of said power tool relative to a work piece; and
 - a switch assembly supported on said handle for movement with said handle, said switch assembly being electrically connectable to said motor and operable to selectively connect said motor to a power source.
2. The power tool as set forth in claim 1 wherein said handle is pivotable relative to said housing about said first axis.
3. The power tool as set forth in claim 1 and further comprising means for connecting said switch assembly to said motor to accommodate movement of said switch assembly with said handle and relative to said motor.
4. The power tool as set forth in claim 1 and further comprising a locking assembly operable between a locked condition, in which said handle is fixed in a position relative to said housing, and an unlocked condition, in which said handle is movable relative to said housing.
5. The power tool as set forth in claim 4 wherein said switch assembly is operable between an unoperated condition, in which said motor is not connected to the power source, and an operated condition, in which said motor is connected to the power source, and wherein said switch assembly, in the operated condition, prevents said locking assembly from being operated from the locked condition to the unlocked condition.
6. The power tool as set forth in claim 1 wherein the power tool is a circular saw.
7. A circular saw comprising:
 - a motor operable to rotatably drive a saw blade about an axis;
 - a motor housing supporting said motor;
 - a main handle supported by said housing for movement relative to said housing, said main handle being graspable by an operator to provide for movement of said power tool relative to a work piece, said main handle being pivotable relative to said housing; and
 - a locking assembly for locking said main handle in a position relative to said housing.
8. The circular saw as set forth in claim 7 wherein said main handle is pivotable about said axis.
9. A circular saw comprising:
 - a motor operable to rotatably drive a saw blade about an axis;

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- a motor housing supporting said motor;
- a main handle supported by said housing for movement relative to said housing; and
- a switch assembly including a switch and supported by said main handle for movement with said main handle, said switch being electrically connectable to said motor and operable to selectively connect said motor to a power source.

10. The circular saw as set forth in claim 9 wherein said switch assembly is movable relative to said motor, and wherein said circular saw further comprises a wiring arrangement electrically connecting said switch to said motor and accommodating movement of said switch assembly relative to said motor.

11. A method for assembling a circular saw, said method comprising the acts of:

- providing a motor operable to rotatably drive a saw blade about an axis and connectable to a power source, a motor housing, and a handle;
- supporting the motor in the housing; and
- supporting the handle on the housing for movement relative to the housing.

12. The method as set forth in claim 11 wherein said act of supporting the handle includes supporting the handle for pivoting movement relative to the housing.

13. The method as set forth in claim 11 and further comprising the acts of:

- providing a switch assembly;
- supporting the switch assembly on the handle for movement with the handle relative to the housing; and
- electrically connecting the switch assembly to the motor so that the switch assembly is operable to selectively connect the motor to the power source.

14. The method as set forth in claim 11 and further comprising the acts of:

- providing a locking assembly;
- supporting the locking assembly on at least one of the handle and the housing; and
- operating the locking assembly to lock the handle in a supported position relative to the housing.

15. The method as set forth in claim 14 wherein said operating act includes applying a clamping force to one of the housing and the handle to lock the handle in a supported position relative to the housing.

16. The method as set forth in claim 15 wherein said applying act includes applying the clamping force to the housing.

17. A circular saw comprising:

- a motor operable to rotatably drive a saw blade about an axis;
- a motor housing supporting said motor;
- a handle supported by said housing for movement relative to said housing; and
- a locking assembly operable to lock said handle in a position relative to said housing.

18. The circular saw as set forth in claim 17 wherein said locking assembly is operable between a locked condition, in which said handle is locked in a position relative to said housing, and an unlocked condition, in which said handle is movable relative to said housing.

19. The circular saw as set forth in claim 17 wherein said locking assembly includes

- a locking protrusion formed on one of said handle and said housing, and

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a locking recess formed on the other of said handle and said housing, said locking protrusion being engageable with said locking recess to fix said handle in a position relative to said housing.

20. The circular saw as set forth in claim 19 wherein said locking assembly includes

a locking protrusion formed on one of said handle and said housing, and

a plurality of locking recesses formed on the other of said handle and said housing, said locking protrusion being engageable with at least one of said plurality of locking recesses to fix said handle in a position relative to said housing.

21. The circular saw as set forth in claim 19 wherein said locking assembly includes

a plurality of locking protrusions formed on one of said handle and said housing, and

a plurality of locking recesses formed on the other of said handle and said housing, said plurality of locking protrusions being engageable with said plurality of locking recesses to fix said handle in a position relative to said housing.

22. The circular saw as set forth in claim 19 wherein said locking assembly includes

a locking member operable between a locked position, in which said handle is fixed in a position relative to said housing, and an unlocked position, and

an actuating member for operating said locking member between the locked position and the unlocked position.

23. The circular saw as set forth in claim 22 wherein said handle has an upper surface, and wherein said actuating member is located on said upper surface.

24. The circular saw as set forth in claim 22 wherein said actuating member includes a lever portion engageable by an operator and a cam portion connected to said lever portion, said cam portion biasing said actuating member to maintain said clamping member in the locked position.

25. The circular saw as set forth in claim 22 wherein said locking member is a clamping member operable to apply, in the locked position, clamping force to one of said housing and said handle to fix said handle in a position relative to said housing.

26. The circular saw as set forth in claim 25 wherein said locking assembly includes an adjustment member to adjust the clamping force applied by said clamping member.

27. The circular saw as set forth in claim 25 wherein said clamping member is supported on said handle to selectively apply clamping force to said housing.

28. The circular saw as set forth in claim 27 wherein said handle has first and second ends, wherein said clamping member has opposite ends, one opposite end being connected to said first end of said handle and the other opposite end being movably connected to said second end of said handle, and wherein said other opposite end of said clamping member is movable relative to said second end of said handle so that said clamping member selectively applies the clamping force to said housing.

29. The circular saw as set forth in claim 28 wherein said locking assembly further includes

a plurality of locking protrusions formed on one of said handle and said housing, and

a plurality of locking recesses formed on the other of said handle and said housing, and wherein, when said clamping member applies clamping force to said housing, said plurality of locking protrusions is engage-

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able with said plurality of locking recesses to fix said handle in a position relative to said housing.

30. The circular saw as set forth in claim 29 wherein said plurality of locking protrusions and said plurality of locking recesses are provided by a plurality of inter-engaging teeth formed on each of said handle and said housing.

31. The power tool as set forth in claim 1 wherein said handle is a main handle, and wherein said power tool further comprises a second handle supported by the housing, said main handle and said second handle being graspable by an operator to provide for movement of said power tool relative to a work piece.

32. A power tool comprising:

a housing;

a motor supported by said housing and operable to drive a tool element relative to a first axis;

a handle supported by said housing for movement relative to said housing about a second axis generally parallel to said first axis, said first axis and said second axis being fixed relative to said housing, said handle being shaped to be grasped by an operator to provide for movement of said power tool relative to a work piece, said handle being movable relative to said housing between a first position and a second position, said handle being operable, in said first position and in said second position, to move said power tool relative to a work piece; and

a switch assembly supported on said handle for movement with said handle, said switch assembly being electrically connectable to said motor and operable to selectively connect said motor to a power source.

33. The power tool as set forth in claim 32 wherein said handle is movable to a third position, said handle being operable in said third position to move said power tool relative to a work piece.

34. The power tool as set forth in claim 33 wherein said third position is between said first position and said second position.

35. The power tool as set forth in claim 32 wherein said handle is pivotable relative to said housing about said first axis.

36. The power tool as set forth in claim 32 and further comprising means for connecting said switch assembly to said motor to accommodate movement of said switch assembly with said handle and relative to said motor.

37. The power tool as set forth in claim 32 and further comprising a locking assembly operable between a locked condition, in which said handle is fixed in a position relative to said housing, and an unlocked condition, in which said handle is movable relative to said housing.

38. The power tool as set forth in claim 37 wherein said switch assembly is operable between an unoperated condition, in which said motor is not connected to the power source, and an operated condition, in which said motor is connected to the power source, and wherein said switch assembly, in the operated condition, prevents said locking assembly from being operated from the locked condition to the unlocked condition.

39. The power tool as set forth in claim 32 wherein the power tool is a circular saw.

40. The power tool as set forth in claim 32 wherein said handle is a main handle and further comprising of a second handle.

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